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COMPRESSED AIR MAGAZINE
EVERYTHING PNEUMATIC

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PEACE AND WAR TEACH AND HELP EACH OTHER

How a great governmental agency engaged in saving the lives of miners and promoting the welfare of the industry, at the call to arms was instantly turned into an engine of death and destruction to enemies, is detailed in the annal report of the Bureau of Mines, Department of the Interior, by Van. H. Manning, the Director.

The report, which closes with the fiscal year June 30, while the United States was still at war, tells of the strenuous part played by the Bureau of Mines in assisting to build up the terrifying machine of death that would not have been felt with its fullest force by the Hun until the following spring. With the cessation of war the Germans, it is said, will never be able to realize what the full force of America's military might would have been, or the many devices and methods that were the result of American ingenuity, for the War Department is keeping the best of these a profound secret.

LESSONS OF THE WAR WILL SAVE MINER'S LIVES

At the same time great good for the future peaceful pursuit of industry in this country and for the saving instead of the killing of men has come out of this welter of death-dealing experiments, is the claim of the Bureau of Mines. Certain experiments with delicate instruments known as microphones and geophones, in order to detect the direction and the distance of enemy mining work in tunneling and the location of enemy artillery no matter where placed, has disclosed that these same instruments can be of use in determining the location of men entombed in mines following disaster. It is expected that, if the men have the presence of mind to make even a slight noise, the rescuers listening with these devices will be able at once to locate the men and begin the rescue work. Men thus entombed have been known to live for a week or longer under such circumstances, the rescuers being unable to find them. Other men have died before they could be located. The bureau will equip its rescue cars as soon as possible with these devices.

WAR EXPERIENCE TEACHES COAL SAVING

The war experience of the bureau is going to help peace industries in still another direction. The coal experts, eager to do their share in winning the war, were assigned to the testing of boilers to be used in the ships of the Emergency Fleet Corporation. Speed and the saving of coal were demanded. The result was that the experts so changed the design of the boilers that the coal heretofore necessary to send the ships along for six miles was sufficient to carry them seven miles. This great saving will be available in peace times.

Early in the war every experiment station of the bureau in the mining districts of the country at once closed its peace activities and marshalled for war. The entire bureau and its men and equipment were offered to the two war services. Especially pressing scientific problems were allotted to the different stations, and where the bureau did not have all the men necessary, it turned over its laboratories and equipment to the men assigned by the War and Navy Departments. In this way a central-control laboratory for the testing of materials of war was established at the Pittsburgh station of the bureau by the Ordnance Department. Steel for cannon, material for cartridges and other materials used by the Ordnance were here tested for flaws and weaknesses. The War Department was determined that no soldier, in the emergency of battle, would be able to say that his gun failed him because of faulty material.

The War Department next seized upon the opportunity of using the bureau's explosive station and bomb-proof a few miles from Pittsburgh and there many important, yet secret tests into the action of new and deadly explosives, were made under the supervision of the bureau's and armies' experts. Information of the greatest importance to the war-making powers was obtained.

GAS DEVELOPMPNT

Early in February, 1917, when war between the United States and the Central Powers seemed inevitable, the bureau offered its services in the study of poisonous gases and gas-masks to the War Department which was accepted. This was the beginning of the great organization of 1,700 chemists who constituted the Chemical Warfare Service at the American University at Washington and whose jurisdiction was afterwards turned over to the War Department. The bureau claims that as a result of its work, the United States was months ahead of where it otherwise would have been and the soldiers all had gas-masks of such quality that the War Department some time ago issued a statement to the effect that the gassing of a soldier was to be considered in the future as a matter of ignorance. Still further it is claimed by the bureau that through the energy of its research organization, the large-scale production of toxic gases was far ahead of the supply of shells.

Through its investigation of natural gases the bureau with the cooperation of the Army and Navy conducted important work relating to balloon gases. This work included the development of certain products for use in balloons that can be obtained from natural gas. No more can be said about the work at this time.

WAR MINERALS

It was soon found that there would be a tremendous demand by the military authorities for the so-called war minerals. With the havoc wrought by the submarines, the world was short of shipping and the United States was informed that these minerals should come from American mines, many of which were either inadequately developed or not developed at all, because this country had been depending on foreign sources of supply. The bureau was called upon to furnish these minerals and within a few months there had been developed a sufficient quantity of some to supply all war needs and a surplus of others. It is now said by the bureau that the metal mining industry has received such an impetus by this war demand that it will be in peace times a much greater and more prosperous industry than ever before. "America has been discovered by Americans," said Secretary Lane when he heard how the industry had responded to the war call.

LIQUID OXYGEN EXPLOSIVES

Whatever may be our confidence, or lack of confidence, in the ultimate extensive employment of liquid air or liquid oxygen for mining explosive, we cannot fail of interest in the experiments and developments in that direction. From the beginning of the World War military necessity compelled the German authorities to requisition the entire stock of nitric explosives. This created an emergency which gave Oxiliquit its opportunity, and a sketch follows telling a little about what is being done and how it is done in the employment of liquid oxygen for explosive service in mining.

The explosives which have come into almost universal employment for both military and industrial purposes are generally mixtures or definite compounds containing two essential constituents: a combustible element, carbon, and an ignition element, oxygen. The explosion is the result of the abrupt and violent combination of these two elements.

Oxygen is introduced under the form of nitric combination (nitric ether, nitric derivatives, nitrates) or chlorinated combination (chlorates of perchlorates); carbon in form of an organic matter (cotton, phenol, toluene, etc.). It is therefore easy to see that in ordinary explosives the combination of the active elements carries with it a considerable dead weight, constituted by the other elements (nitrogen, chlorine, potash, etc.).

It is not so with oxyliquit; here the liquefied oxygen is put in contact with carbon in a divided and porous form. Under a system of ignition the combination takes place with explosion, and in principle the procedure is perfect. In the evolution of this process, however, which was first invented by Linde in 1895, many difficulties were encountered.

Liquid oxygen is always produced on the spot where it is to be used, as it is impossible to keep it very long, notwithstanding all the precautions taken against volatilization. It is prepared by liquefying the air, the mixture so obtained of liquefied nitrogen and oxygen being submitted to a partial distillation, which eliminates the larger part of the nitrogen, more volatile than the oxygen. The resulting bluish liquid contains about 85 per cent. of oxygen.

The German society for the exploitation of the Linde patents is able to furnish installations giving an hourly output of 10 kg. (23 lb.) of liquefied rectified oxygen. The price would be about 25 centimes per kilogram, including amortization and interest on capital invested.

To transport the liquefied oxygen from the place of production to the place of utilization, mine or quarry, a new container was necessary.

In the laboratory, glass vessels, socalled "Dewar" bottles, having double walls with a vacuum between, have been used for the keeping of liquefied oxygen. These bottles are not closed—on account of the danger of a closed bottle in handling—but, thanks to the good insulation, the loss of oxygen by evaporation is very small (about 50 grammes per hour, or 17.5 oz.).

These glass bottles, easily breakable, are not convenient for wholesale manufacturing nor for use in the workshop. They are now replaced by containers of metal—especially brass and steel—and these give excellent service.

The steel or brass bottles do not hold the vacuum as well as those of glass—being more porous—and the vacuum must be often renewed. To lessen this inconvenience, Dewar inserts between the walls very porous charcoal.

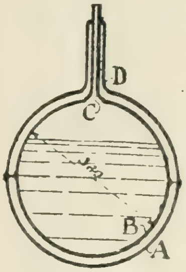


Fig. 1

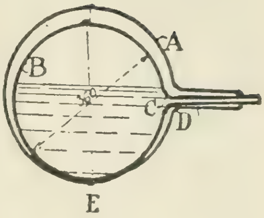


Fig. 2

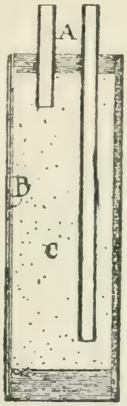


Fig. 3

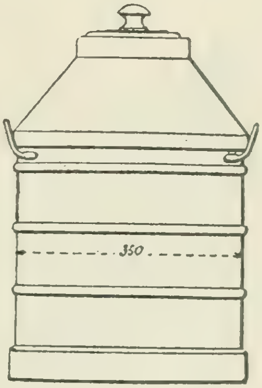


Fig. 4

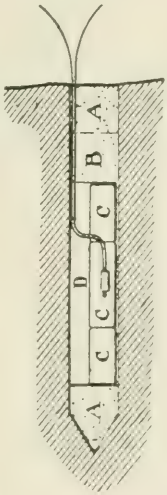


Fig. 5

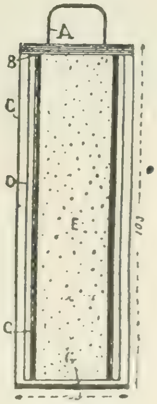


Fig 6

LIQUID OXYGEN PRACTICE

When the vacuum is made and the bottle filled, the annular space between the walls takes a temperature of—190° C. (—372 F.) the normal boiling point of the liquid, and the charcoal gets extremely porous and absorbs with great avidity the little gas that passes through the pores of the metal. The insulation power of the receptacle is well maintained for a long time. The containers, of a spherical form, which serve for the transportation have a very slender neck in order to lessen evaporation. This slender neck would make decanting difficult, as the air which must take the place of the outflowing liquid cannot come in at the same rate of the liquid coming out. Therefore the neck of the inner bottle B, Fig. 1, which does not touch the external wall A, has been elongated; when the bottle is tilted, the interior tube, long and with thin walls, is bent; the inner bottle touches the outer at D and E, Fig. 2; the insulation is interrupted; there is a warming up of the space, and the warmed up liquid—partly evaporized—creates an interior pressure which drives the liquid through the thin neck. It is thus possible to pour out quickly and steadily.

The combustible material must be rich in carbon, and also porous, so as to come into intimate contact with the liquid oxygen. Several have been tried; a mixture of gasoline and infusorial earth (Kieselguhr), in proportion of 40 to 60; a dry wood pulp; finely pulverized cork; dried peat; lampblack. This latter showed its unqualified superiority over all other material.

USE OF CARTRIDGES.

By what is known as the Kowastsch method, the liquid oxygen is poured upon the lampblack in the bore hole. A cylindrical cardboard cartridge is made of the same diameter as the hole, Fig. 3; this cartridge B contains the lampblack C, or other porous material rich in carbon. It is closed at both ends with cardboard or cork. Two small tubes A, of thin cardboard, pierce the stopper at the outer end. These tubes serve for the pouring of the oxygen, also for the ignition system (fuse or electric). The cartridge being thus made, a metal rod is inserted in each tube to prevent them being crushed, and the cartridge is deposited at the bottom of the hole. It is then packed with a wad of clay. The metal rods are then extracted and the liquid oxygen poured in through the larger tube by means of an elbow funnel. The gaseous air escapes by the shorter tube, and also the overflow of liquid oxygen when the cartridge is saturated completely. The cartridge is now ready for the firing. The explosion is comparable to that of dynamite.

The Marsit method allows of a more regular working; it is therefore more in use than the other. Here the cartridge is saturated before being introduced into the bore-hole. To do this the cartridges are immersed in a special vessel of cylindrical shape with double walls, filled with liquid oxygen, Fig. 4. The cartridges are left first exposed for a few minutes to the vapors above the liquid to cool them off, then completely immersed for half an hour. The saturation is therefore complete. When the cartridge is saturated it is taken out and the ignition system attached as quickly as possible. It is then placed in the bore-hole and tamped, Fig. 5, and exploded.

The manipulation in this method is far simpler than in the first mentioned. The only inconvenience is the unavoidable delay between the taking out of the cartridge and the placing in the bore-hole. During the lapse of these few minutes a certain part of the oxygen of the cartridge evaporates. To lessen this loss and to keep in the lampblack a sufficient excess of oxygen, the walls of the cartridge are made watertight; they are of corrugated cardboard. Fig. 6 shows this cartridge, called the Messer cartridge, which is very much in use. This make-up explains the long duration of the immersion. But in this way the cartridges keep their strength for 8 to 10 minutes after they are taken out of the liquid oxygen.

There is no need of a detonator to explode these cartridges, and this is one of the advantages of the new method; all that is necessary is a small primer ignited by a fuse or by electricity.

PRACTICAL RESULTS.

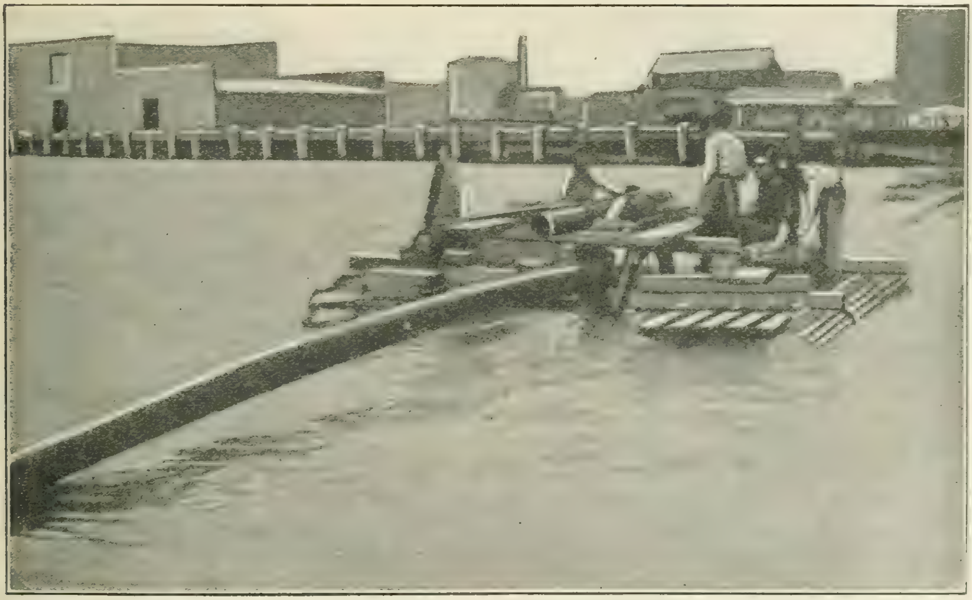
The principal company manufacturing oxyliquit, the Sprengluft Gesellschaft, m. b. H., of Berlin, claims to have delivered each year an equivalent of 10,000 tons of nitric explosives. Even allowing for probable exaggeration, that shows how widely this product is used in Germany. Its greatest advantage over other explosives is that it almost entirely eliminates the danger of accidents. The cartridge itself is explosive for about 10 minutes only, between the time of its saturation and the time of its ignition. During this time the danger is not any greater than with any other explosives. The result is that in case of a miss it is only necessary to wait half an hour for the cartridge to become entirely harmless, and then one can uncover the bore-hole without any danger. What is more, all dangers inherent to transportation and storage of the explosive are entirely eliminated.

The method, however, has its inconveniences, the principal objection being that it is impossible to store liquid oxygen, necessitating the establishment of a liquefaction and rectifying plant at the place where it is used. Also there is need of very experienced hands for a quick charging of the boreholes.

Theoretically the new explosive can claim superiority over others. In practice, however, it gives an explosion hardly equivalent to the most powerful explosives known, the common dynamite and the gelatine-dynamite.

WELDING A GAS MAIN

The Pacific Coast shipyard of the Bethlehem Shipbuilding Company is on an island in San Francisco Bay, separated from the mainland by a navigable channel spanned by drawbridges and for a gas supply it was necessary to lay an 8-in. pipe in a dredged trench 40 ft. below the water surface. There were two 700 ft. welded lengths of pipe available for the purpose. These two lengths were welded together, the ends were tightly closed to take advantage of the buoyancy and it was pulled across the water. The line was then allowed to fill and it settled down into the trench. Soon after the pipe was placed a section was broken out by a ship so that it had to be taken up to have a piece welded in. This was done by a diver placing chains about the pipe and leading them up to be wound around a pipe supported by barges on each side. This cross pipe above was turned by big pipe tongs and served as a windlass. The ends of the pipe were cut off with the oxy-acetylene cutting torch, which was a most difficult task when passing boats would rock the rafts on which the men were working, and the same difficulty was encountered in the rewelding. The welder found it very difficult to keep his torch and metal at the point of the joint. The job was done successfully, the pipe was tested and lowered again to its place and is now in use. The halftone gives a general view of the operations.



WELDING ON A RAFT

INSTRUMENTS FOR AIR USE*

Let us take a look into an airman's office. I do not refer to the wooden hut on the ground where in bad weather cigarettes are smoked, the illustrated weekly papers read, and aerial operations discussed in professional slang.

I mean the "office" where the pilot does his real work; and this is the name which for some inexplicable reason has been given to the cockpit of an aeroplane, wherein sits the aviator. To the uninitiated it appears a confused medley of dials, recording needles and levers; mysterious, unfathomable, exciting. But to the trained airman these things are as an open book; and each one of them is in some way essential to the control of the machine and its manœuvres.

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*By Lieutenant William A. Robson, R. A. F., Author of "Aircraft in War and Peace."

The most important of the instruments is the compass. Without its aid an airman who is flying over the sea or over land on a misty day is hopelessly lost. In the R. A. F. great attention is attached to the necessity for every pilot being able to fly a compass course; that is to say, a course along which he is guided solely by his compass; and very great progress has been made in this connection. Thousands of miles are flown every week on patrols over the sea alone, and pilots nowadays very rarely come to grief through losing their way.

This is saying a good deal, when the problem presented by draft is remembered. If an aircraft starts from one point to fly to another due east, and there is a wind blowing at 15 miles an hour northeast, that will clearly have to be taken into consideration, and the compass course altered (before ascending) according to the total distance of the journey.

Many difficulties had to be overcome in the production of a satisfactory compass for aerial work. Chief among these was that of neutralizing the magnetism of the engine (and in particular the magneto) and of preventing the effect of centrifugal force, which caused the card or dial inside the compass to swing in a direction quite independent of north when the aeroplane was banking on a turn. However, a truly excellent compass is now in use in the R. A. F., far superior to that employed by the enemy. And indeed it would be odd if the Germans should have proved able successfully to compete in this direction with a nation whose commerce for several hundred years has been largely dependent on the excellence of its ships' compasses.

Probably the next most important instrument is the aneroid or height indicator. This is worked on a simple mercury principle, and is generally fitted with an adjustable dial which can be moved round so that the reading on leaving any given aerodrome is zero. Which reminds one of rather an amusing occurrence. A pilot left his aerodrome for a cross country flight on a very misty day, and carefully set his aneroid to 0. After flying for a couple of hours by compass he thought he must be nearing his destination. He could see nothing below him and so descended to 500 ft. On he flew at this height for another five minutes. Deciding to land, he was about to make a magnificent volplane, when suddenly the mist cleared and he saw ground immediately underneath him, about 10 ft. below. His fathful aneroid still insisted that he was 500 ft. high. The explanation lay in the fact that the place he was about to land on was 500 ft. higher above sea level than the aerodrome when he set out. Trifles like this are all in the day's work and help to teach the young pilot never to become the slave or dependent of mere instruments.

Next we have the tachometer or "rev. counter," which records the number of revolutions the engine is making per minute. This varies from about 1,100 (in rotary motors) up to 1,800 in water-cooled engines. The reading of this instrument is of great interest to the pilot, for modern aircraft are so carefully designed that their performance is affected enormously by even an extra 100 revolutions or so per minute one way or the other.

Another important instrument is the air speed indicator. This tells the pilot at what rate he is rushing through the air. This speed, of course, has no relation to the rate at which he is travelling over the ground. Nor is it intended to, for it is air speed which is of importance to the stability of the aircraft and the safety of the pilot. If a machine flying at 70 miles per hour is travelling against a 40-mile wind, the A. S. indicator will show 110 m.p.h.

Every aeroplane has a minimum air speed at which it must be thrust through the air if it is to be maintained aloft; and a maximum air speed in excess of which it cannot safely be nose-dived, for the various components will not stand the strain beyond a certain given point. It can be seen how essential is this device on a flying machine. Air speed indicators have been fitted to British aircraft for years past and it is interesting to note that the Germans have just commenced to use them.

The next item which calls for attention is the inclinometer. This is a curved spirit level fitted transversely across the machine. It is marked in degrees; and the pilot can tell from it at what angle he is banking his craft when turning.

With the addition of a miniature set of electric light clusters and a neat eight-day watch the list of instrumental equipment is concluded. The only remarkable feature of the watch is that if an aeroplane is left without a guard for five minutes after a forced landnig, the watch mysteriously disappears!

There are several pressure gauges on the dashboard. One for each petrol tank, to indicate the pressure at which air is forcing the spirit to the engine; and another one to show the pressure in lbs. to the square inch at which oil is being driven through the various lubrication channels. On water-cooled engines a thermometer records the temperature of the water in the radiator.

Space forbids a detailed description of the controls. However, it may briefly be said that there is a swivelling foot-bar for the rudder; while a central lever, commonly known as the "joystick" actuates the elevation and banking of the aeroplane. A wheel at the side increases the angle at which the tail plane "attacks" the air, this being for rapid ascension. Two side levers control the speed and petrol consumption of the engine.

Then come the various articles of military equipment. These comprise the machine guns with their actuating gear firing straight through the propeller, and controlled by a lever on the joystick; the wireless outfit in the observer's cockpit; and, finally, message bags, bomb sights, and camera release handles.

And some folk seem to think pilots are not very busy people!—*From Flight.*

PURIFICATION OF COAL GAS BY ELECTRICITY

By M. Meredith.

The deposition of tar and other impurities from coal gas by electrical means has recently been undertaken and satisfactory results have been attained. High-tension direct current is discharged between a cage made of thin wires and a tube, the system of wires being mounted in the middle of the tube. It is essential to prevent access of air to the precipitation chamber in order to avoid the danger of explosion. It was found that the tendency toward the production of harmful discharges is least if the wire electrode is negative. The shape of the electrode is highly important, and the sustaining insulators are specially formed and cemented into the tube. A ½-in. gas tube is passed through a series of cast-iron disks, between which the thin steel wires are fixed. The whole is then placed in a felt-covered tube, which constitutes the grounded electrode.

The apparatus was tested with a flow of 265,000 cu. ft. of gas per hour, two precipitation chambers 4 ft. 11 in. in height and 8 in. in diameter being used. Disks of the active electrode were 4 in. in diameter, and were covered with 16 thin piano-steel wires. The passage traversed by the gas was 12 ft. 4 in. long. The gas was exposed to the electrical discharge for 0.4 second.

After five hours' operation the tar deposited on the insulators was found to interfere with the action. For complete cleansing of the gas 0.2 kw.-hr. was required for each 265,000 cu. ft. The total cost of the apparatus was about $500. The test was made with 20,000 volts and a current of about 3 milliamperes.

The temperature of the coal gas has little influence on the operation. Tar deposited at 175 deg. F. is free from water and suitable for asphalting. It can be cleansed in a washing apparatus and the residue of naphthalene can be reclaimed by a second electric precipitation. The illuminating and heating capacity of the gas is improved if the tar is removed while hot.

THE GARAGE DANGER

With the advent of cold weather it may not be amiss to again revive the oft-repeated warning against running an automobile engine in a closed garage; although it is not likely that it will do much good, as there are always people who, if not entirely ignorant on the subject, will take a chance. The difficulty appears to lie in the impossibility of impressing a realization of how very little of this exhaust gas is necessary to produce fatal results, and inability of many people to understand that a gas that they cannot smell is dangerous. The gas you smell is that of incomplete combustion and from burnt oil; but the most dangerous gas has no odor, and the more perfectly the engine operates, the greater the quantity of the deadly gas. How dangerous it is may be appreciated from the fact that an amount as small as one-twentieth of one per cent. in the air breathed is sufficient to produce poisonous results.—*Scientific American.*

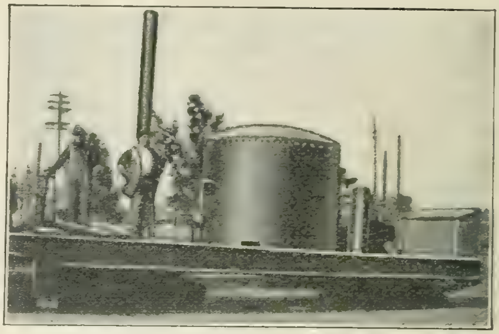
AVIATION SCHEMES

One great advantage of the war has been the forced development of aviation, and it is certain that a product of peace will, within a short period, result in the aeroplane becoming one of the most common and ever-increasing methods of long-distance locomotion for passenger, postal, private and commercial purposes. Ideas—possibly fantastic to the unimaginative and unknowing—are now being prepared in readiness for a wonderful future. "Witecraft" airlines, to encircle the globe and having a vast central aerodrome already in existence at Whitehead Park, close to London, is a proposition taking concrete form. The plan is designed to establish associated aerodromes in various parts of the earth to assist greatly in linking together the world's commerce. In regard to flights between England and America, Mr. J. A. Whitehead, of Whitehead Aircraft (1917), Ltd., takes a daring gaze into the future by hinting at the creation of flexible floating aero-stations in the Atlantic Ocean. These harbors for aircraft would be kept in position under their own power.—*Mining World,* London.

AIRCRAFT EVOLUTION

The United States War Department authorises the following statement of evolution in aircraft engines prepared by the National Advisory Committee: The first man-carrying airplane flights were made in December, 1903, with the Wright Brothers' engine, developing 12 horse-power and weighing 12.7 lb. per horse-power. In 1910, seven years later, the average horse-power of aeronautic engines had increased to 54, and the weight decreased to 5.7 lb. per horse-power. In March, 1918, the Liberty 12 developed 432 horse-power for a weight of 1.86 lb. per horse-power. By May, 1918, the Liberty 12 was yielding a maximum of 450 horse-power for a weight of 1.83 lb. per horse-power. The Langley-Manly engine, built in 1901, was nine years ahead of its time in the matter of power output, and sixteen years ahead in its weight per horse-power, developing 52 horse-power, and weighing 2.9 lb. per horse-power.

Italy is making arrangements for the transport of wounded soldiers by aeroplane. The Caproni machine, it is said, will carry ten to twelve stretchers.



PNEUMATIC SAND CAR

PNEUMATIC SAND CAR FOR DENVER STREET RAILWAYS*

In the operating of street railways the distribution of sand to be used along the tracks, although perhaps a minor detail, is still a constant requirement. The scarcity and the increased cost of labor has led the officials of the Denver Tramway to develop and adopt the sand car here brought to the attention of our readers.

The car is 35 ft. long over all and has a steel underframing of 15 in. channels. It weighs 50,000 lbs. when fully loaded and 29,600 lbs. empty. The sand tank is 6 ft. by 7 ft. 6-in. in dimensions and has a net capacity of 8½ cu. yd., or approximately 10 tons. The air pressure used for unloading the sand is furnished by a D4K Westinghouse motor-driven air compressor mounted on the sand car. Air connections are also provided so that

DISTRIBUTING THE SAND

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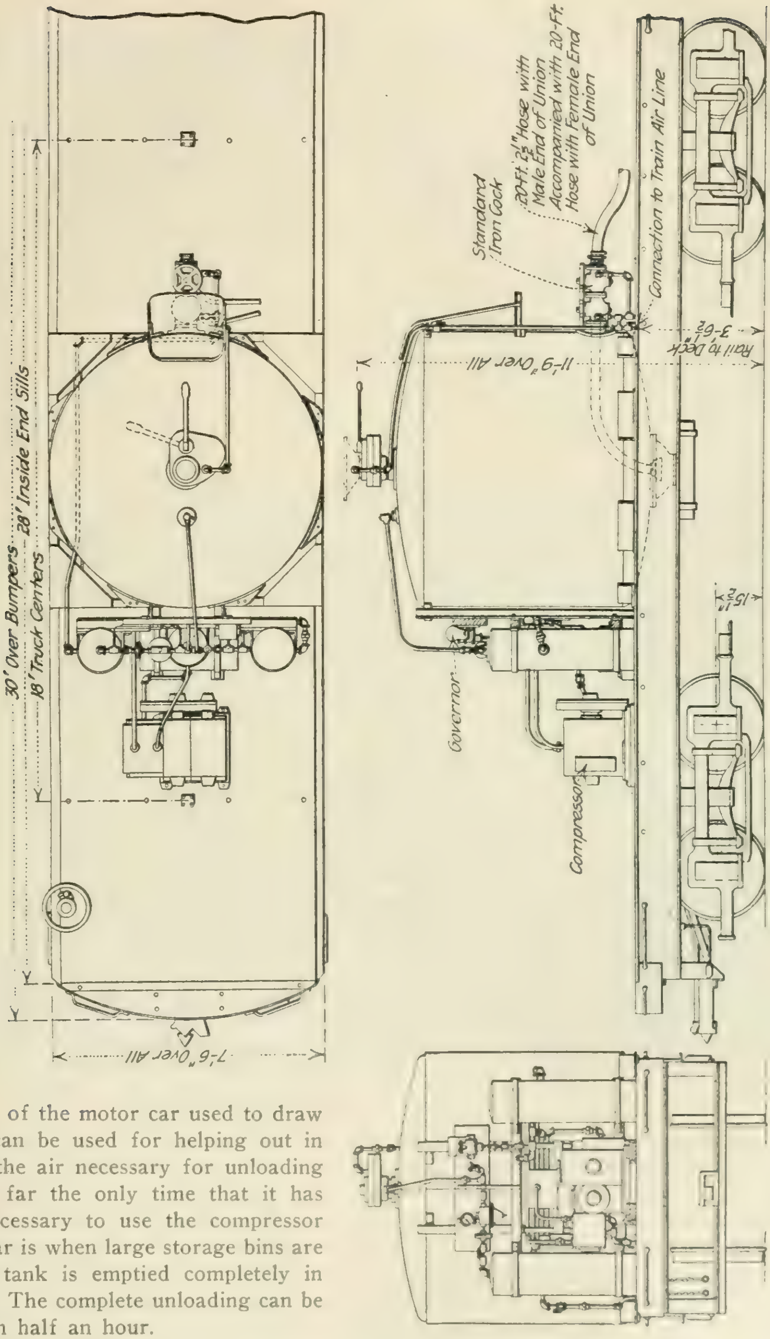
*By W. L. Whitlock. Abstract from *Electric Railway Journal.*



DETAILS OF PNEUMATIC SAND CAR

the compressor of the motor car used to draw the sand car can be used for helping out in the supply of the air necessary for unloading the sand. So far the only time that it has been found necessary to use the compressor of the motor car is when large storage bins are filled and the tank is emptied completely in one operation. The complete unloading can be accomplished in half an hour.

The compressor on the sand car is cooled by means of a water jacket. The necessary water supply is obtained from a storage tank mounted on the car. For unloading the sand 25 lb. air pressure is used. Three receiving tanks, two of which are 14 in. x 48 in., and one 14 in. x 33 in., take the air from the compressor at from 60 lb. to 75 lb. pressure. A reducing valve, installed between the last tank and the air connection to the top of the sand tank, reduces the pressure to the working value of 25 lb. The tank is filled from sand bins by gravity through a valve in the top. After filling, this inlet valve is closed and the air compressor is started while the car is on the road to its destination, so that on arrival no waiting for air pressure is necessary. A 2½-in. rubber sandblast hose conveys the sand from the tank to sand boxes or bins. This hose is 40 ft. long, and is divided into two sections for convenience so that a shorter length can be used where the full length hose is not required. The usual type of sand box which is located at the end of the car lines is filled in five minutes. The capacity of these boxes is 1 cu. yd.

Small air lines are tapped into the tank at the inlet and outlet valves. By means of these lines sand can be blown away from valves in case there is any tendency of the sand to stick or pack at these points. In addition these hose lines provide an effective method for cleaning valve seats, which facilitates the valve operation. A motorman and a brakeman are the only men required to operate this equipment, thus producing a saving of three laborers and a large part of the time necessary for filling boxes.

AVIATION AND MINING

The influence of aircraft after the war upon the future of mining is likely to be of a potent and enduring kind. The help aircraft is capable of giving must facilitate operations to a great extent. Difficulties that were formerly insurmountable, save at the cost of much time, may now be overcome in greatly shortened periods. A manager is suddenly required to proceed to the mine, with respect to which something is radically wrong. The manager in question can fly to the spot, literally as well as figuratively, as Mr. Bonar Law did to the Paris Conference a few days ago. The distance the manager has to traverse may be greater than that covered by the Chancellor of the Exchequer, but it can be taken in stages, and early arrival may prevent much from happening that may be deleterious to the company's interest. This applies particularly to mines in isolated spots as yet uncivilized by railways, and only accessible by a fatiguing journey on horse or mule, extending, perhaps, over many days. From an air base, duly established, such a journey might be accomplished in a few hours, and the general effect would be to bring mines from great commercial centres, and particularly from London, into much closer connection than heretofore. Important communications which formerly took a month to reach the spot and a month to get a reply, might now be reduced to a limit of as many weeks. Aircraft will come to be, for isolated localities, the natural supplement of the telegraph.

Nor will the advantage of aircraft be confined to rapid personal communication. Will it not be possible to send urgently needed goods in the same way? If Zeppelins could carry to London, and deposit upon its streets tons of bombs, will it be beyond the wit of man to send machinery and urgently needed appliances through the air? Shakespeare foresaw the telegraph, when he says in "A Midsummer Night's Dream":—"I will set a girdle round the earth in 40 minutes"; just as he may have foreseen aircraft when he speaks, in "Macbeth," of being "horsed on the sightless couriers of the air." The vista that aircraft opens to the world, and to mining as part of it, is so all-embracing that one is lost in contemplation of the depths and heights—particularly the heights—to which it may attain.

Let us suppose that, in a distant country unprovided with railways, a mine needs a new part for one of the engines, or even a new engine itself, which can only be obtained in this country, where, indeed, it ought to be obtained if at all possible, for after the war, let us hope, we shall work together more closely as a people than we did before it. A British manufacturer provides the article required, and it is "shipped" by aircraft in stages, until the destination is reached—perhaps months earlier than could have been possible under the old *regime*. There would be rapidity of progress, no transhipment from the time of leaving the workshop until that of arrival on the mine—only arranged stopping places *en route* to obtain fresh power, and overhauling for the machine, with rest and recuperation for the crew. "Oh!" but some will say, "what about accidents?" But do no accident occur by railway, or at sea? Inventive genius has not said its last word with respect to aircraft, and, it will be a long time before it does.

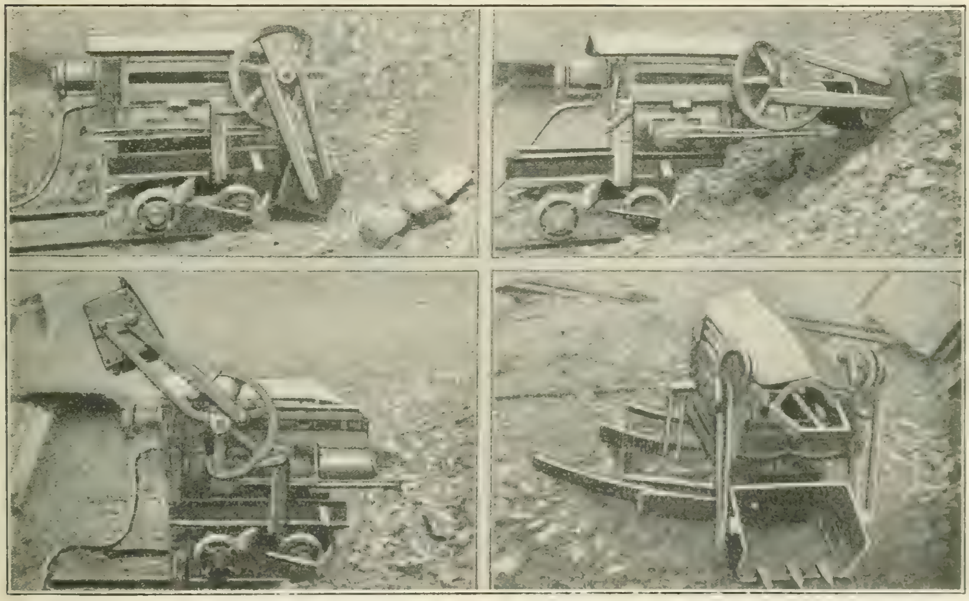
Talking of the question of intercommunication, this need not be confined to the managers of mines. Directors might take a trip to see the property they are administering, which, under present conditions, very few of them ever have done or ever dream of doing. It would be a spectacle for the gods to see a body of directors start from a London office, with the secretary in attendance, to visit a mine thousands of miles away, performing the journey in a flying machine. Indeed, we may expect at no distant date a qualifying test for a director to be his willingness to visit the property *via* the air. Before being re-elected, a shareholder, in meeting assembled, may be expected to ask—"Are you prepared to pay a literally flying visit to the property?" to which the director would suitably reply—"Yes, provided that the fee paid me be proportionate to the risk!"—*Mining World,* London.

THE ARMSTRONG MINING SHOVEL

The enormous quantities of material now handled by steam shovels in open cut mining has enforced the necessity for a similar machine for underground work and this has led to the development of the ingenious and effective Armstrong air operated mining shovel here shown in a group of photos reproduced from a recent issue of *Engineering and Mining Journal.*

The shovel consists of three principal parts: A truck suitable to the gage of the mine track; a platform that permits lateral swing, and a body-piece that rolls forward and back on a track provided by the platform. The body-piece consists of four cast-iron cylinders and a crosshead, which travels in horizontal guides and carries rope sheaves, the dipper arms, and the dipper.

In operation, the swinging of the shovel is done by hand, and the shovelling motion is obtained by the cylinders, which use direct air and requires no gears, clutches, belts, or conveyers. The bottom cylinder pushes the body piece forward, the center cylinders turn the dipper through 90°, and the top cylinder pulls back the crosshead. This carries the dipper up and over, where it is discharged into a car at the rear of the shovel. Simultaneously, the bottom cylinder pulls the body-piece to the rear, and this reversal brings the dipper back to the starting position in the front of the shovel. Each of the center cylinders is provided with a plunger piston, the center of which is bored and contains a stationary piston anchored by a rod to the back head, the space inside this latter piston being partly filled with oil. The effect of this arrangement is to limit the speed of the digging part of the stroke. This is necessary when the dipper strikes a solid piece of rock and the resistance causes a temporary building up of air pres-



PNEUMATIC MINING SHOVEL

sure behind the piston. Without this provision the dipper, in sliding to one side of the obstruction, would be thrust suddenly forward, causing all the dirt to be thrown out.

The bottom cylinder which crowds the body-piece forward and pulls it back is smaller than the center cylinders and exerts a forward push at the point of the dipper-lip of about 1,200 lb. The pressure given by the center cylinders is 3,600 lb., so that if the dipper catches on solid ground, the push of the center cylinders will overcome the forward thrust of the bottom cylinder and thus force the body-piece back until the dipper clears the obstruction. Then, owing to the oil control, the dipper will move up slowly, while the bottom cylinder, with no oil control, shoves the body-piece ahead quickly, burying the dipper in the dirt after clearing the obstruction.

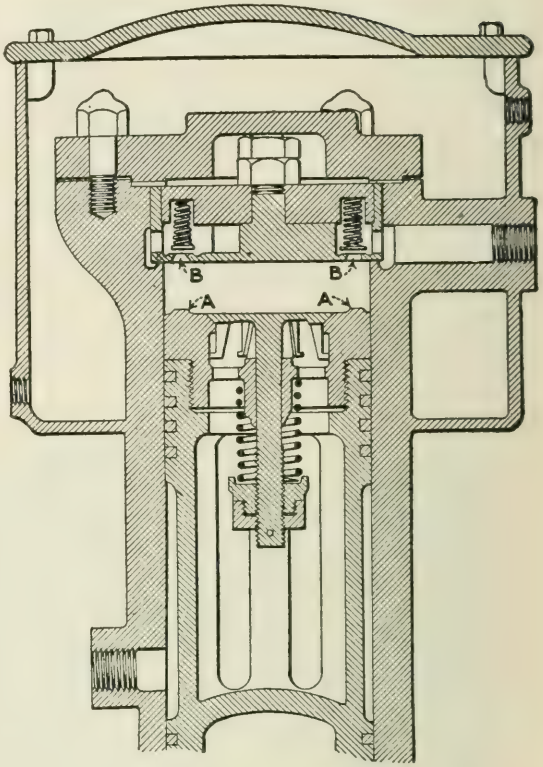
The shovel is 6 ft. long, 4 ft. wide and 4 ft. high, and on the upper extension allows headroom of 6 ft. 8 in. above the top of the rail. The swing allows a clean-up 9 ft. The daily capacity depends not upon the machine itself but upon the rapidity with which cars are supplied. It is claimed that a small shovel loaded 105 tons in seven hours at the plant of the American Zinc Company, Mascat, Tenn.

The shovel is built by the Armstrong Shovel Company, Vulcan, Mich., F. H. Armstrong, president and general manager.

DEEP MINING ON THE RAND

The lowest workings on the main incline from the Turf Mines shaft of the Village Deep have now reached sea level, i. e., 5,633.69 ft. vertical, which is the greatest depth at which mining is now done on the Rand. All the natural obstacles to working at this depth have been successfully overcome. The rock pressure has proved the chief obstacle, but this has been countered by the special methods of support adopted. The increased heat has likewise been offset by adequate ventilation.—*Sou. Af. Min. Journal.*

The highest reading ever attained by the barometer in New York City, according to Weather Bureau records, is 30.93 inches; the lowest, 28.61 inches.



SECTION OF CYLINDER

HIGH SPEED COMPRESSOR

The accompanying cut shows the essential features of an air or gas compressor designed to be direct connected to an oil or gas engine and consequently to be run at high speed, which of course means large capacity for size of unit. There may be two, three, four or even six cylinders similar to the one here shown in section all connected to a single crank shaft below. The special feature to which attention is called in this machine is the elimination of clearance at the termination of the stroke, which will be self-evident from a look at the drawing. The air is admitted by a valve in the trunk piston, the valve when closed being flush with the flat top of the piston. The flat top of the piston travels close to the flat face of the cylinder head above. Upon the flat face of the piston there is a ring projection A which enters and fills the annular valve pocket B in the head. The compressor is built by the Niebling-Markstein Company, 201 Bell Block, Cincinnati.

TESTING A NEW BREATHING APPARATUS

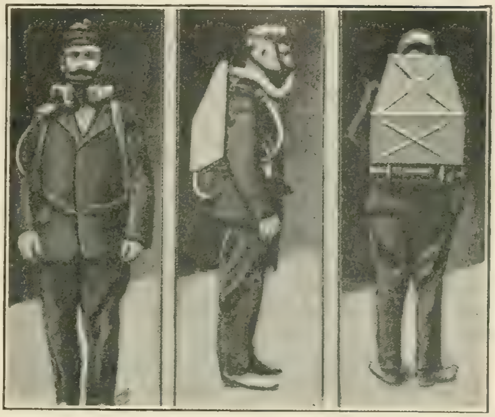
By John Lyons.

In order to test the new Gibbs standard two-hour breathing apparatus a number of employees of the Madison Coal Corporation on October 4 last journeyed by automobile to the Illinois state mine rescue station at Benton, Ill. The party was composed of William Turton, district superintendent; John Lyons, rescue foreman; Herschel Harriss, assistant mine foreman; John Lauder, face boss, and Fred Schoonover, safety inspector.

These men were well received by James Weir, superintendent in charge, who clearly described the different types of safety lamps and rescue apparatus kept at the station. The new Gibbs apparatus was explained and the machine thoroughly tested for leakages, careful note being made of the amount of oxygen contained in the cylinder at the start of the test and the amount used in a given time.

John Lyons was the first to wear the machine, the gage at this time showing 135 atmospheres. He performed work in the smoke gallery, such as pulling the 50-lb. weight, sawing props, crawling through the 17x19-in. tunnel, carrying a 130-lb. dummy single-handed round the gallery and then carrying the body end of a stretcher bearing a 160-lb. man with another man carrying the foot end. Lyons worked as fast as possible, not stopping at any time to rest. Unfortunately no record was kept of the actual work done. At the end of 30 min. the apparatus was taken off. The gage now read 75 atmospheres, showing that during the work-period of 30 min. 60 atmospheres of oxygen had been used, or almost one-half the capacity of the cylinder when fully charged. This amount equals 116 liters, or an average of 3.86 liters per minute for the 30 minutes.

Without recharging, Mr. Harris at this point put on the apparatus, with the gage showing 75 atmospheres. A correct record was kept of the work performed by him, which was as follows: Trips around gallery (100 ft. per trip), 29; pulled 50-lb. weight 3 ft. high 90 times; pushed pit car a distance of 60 ft. 16 times; carried 130 lb. dummy single-handed 360 ft.; sawed props 4 in. in diameter with dull saw once; went through a 17x16 in. tunnel once. The total time occupied during this work was 30 min., and the total amount of oxygen used was 40 atmospheres, or 77 liters, being an average of 2.56 liters per minute.



GIBBS BREATHING APPARATUS

Mr. Schoonover then put on the apparatus without recharging, the gage reading 35 atmospheres. He walked round the gallery for 10 min. and was then forced out because he had no oxygen in the cylinder. The gage readings showed that he had used 35 atmospheres in 10 min., equal to 67 liters, or at the rate of 6.7 liters per min. Undoubtedly there must have been something wrong with the gage, causing it to register more than the cylinders actually contained. No person under any condition, no matter how hard the work, is capable of using up so much oxygen. Experts consider that 3 liters per minute would be the maximum quantity used in hard work.

Special attention was given to the behavior of the automatic feed valve on the apparatus, which is said by the makers to allow sufficient oxygen to the wearer no matter at what speed he may be working, and to reduce the quantity passing when the wearer ceases work or rests; also the temperature of the inhaled air from the breathing bag. The three wearers all agreed on the following opinions:

That at no time did they have to slacken their speed because the automatic valve was not delivering sufficient oxygen, enough being supplied at all times.

While the purifier got so hot that it could not be touched with the bare hands, the temperature of the inspired air did not seem to rise perceptibly throughout the trials.

At no time did the breathing bag get so full as to make it uncomfortable to breathe against.

This is brought about by the automatic release valve, which releases the air in the breathing bag when it reaches a certain pressure. However, it was thought that owing to this valve releasing easily it might have been the cause of using up such an excessive amount of oxygen during the period of 70 min. in which the apparatus was worn.

The center of weight of the apparatus is too high on the back, causing the person wearing it to have to lean forward in order to maintain its balance. A glance at the side view photograph accompanying this article illustrates this clearly.

It was also thought that the casing that covers the main part of the apparatus could be made a little lower. The present type comes too much in contact with the wearer's head when he bends down for such work as pulling the weight.

There should be some different arrangement for holding the gage when this is not being read. The wire clips now in use allow the gage to jump out when the wearer of the apparatus is using a saw or pulling the weight machine.

The foregoing trials were made with men well trained in the use and care of mine-rescue breathing apparatus. They are members of the rescue brigades which are maintained by the Madison Coal Corporation at its Carterville mines. These brigades have helped the state teams at explosions occurring in the southern Illinois coal field during the last four years, including the recent disaster at Royalton.

ICE IN AIR PIPES

By *A. A. M.*

Every plant using compressed air is troubled with ice forming in the pipes or machines during cold weather. On ship work, which is generally conducted out of doors, this trouble may cause a complete shutdown. Although various remedies have been applied by the different yards, there seems to be no generally accepted plan for eliminating this trouble. In considering a remedy, the cause should first be determined. Of course, if there were no water in the pipe, or if the temperature were maintained above freezing, there would be no ice, regardless of the water content.

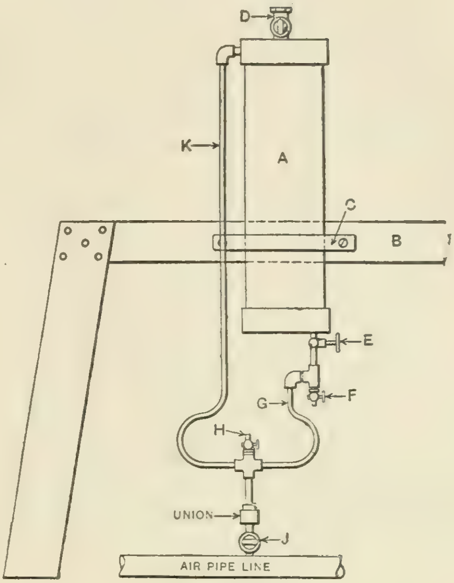
One of the eastern yards found that during cold weather the air drawn from the low points on the line was more like a spray of water than a jet of air, and that in a few minutes ice formed in the hose or in the contracted passages of the lines or machines and cut off the pressure, with the result that considerable time was lost daily. As a remedy, a pipe coil that had been used for heating was connected to the line and a fire built on top of it. Although the air passing through this coil was raised to a high temperature, after it had passed through fifty feet of the hose it would freeze again. Owing to the lack of mechanical care in the application of the heat, a fire sufficient to maintain steam in a 10-horsepower boiler was not able to deliver warm air to the machine; besides, the air compressor was taking air from inside the engine room, where the worst possible conditions existed both as to the amount of water contained in the air and the economy of compression. Lowering the temperature of the intake air 50 degrees increased the amount of air delivered to the pipes about 10 per cent.

In another yard, a small cast-iron manifold was made in which a steam jacket surrounded the air passage. While the air passing through this manifold was heated successfully, it cooled very rapidly after entering the air line. By placing a steam covering on the air hose, warm air was delivered to the machine, but sometimes the hose was burned; furthermore, the expense of maintaining a steam line out of doors to remote parts of the yard was a large item, so that other methods of heating were tried. In one of these, manifolds were placed in the top of sheet-iron pots, in which coal fires were kept burning. For use inside the ships, some manifolds were rigged up and heated by kerosene blow-torches and the shortest possible hose connection was placed between the heater and the machine.

Nearly all shipyards have used alcohol in the air-pipes in some way or another. One yard places five gallons of alcohol into the main receiver at one time. For a while there is perfect freedom from ice throughout the line, but this plan involves the shutting down of the air-compressor for several minutes, and, at best, is not effective for more than an hour. In some other yards, the injection of the alcohol is left to the individual initiative of the machine users. When a man becomes impatient from the delay, he obtains an order from his foreman to procure the alcohol from the storehouse; he then disconnects his hose and pours in some of the alcohol, thus relieving the ice situation for a short time.

In theory, heating the air is the best plan, but in practice it involves more trouble than the average man is likely to take. The use of alcohol is perfectly satisfactory from an operating point of view, but some convenient and economical provision for injecting it into the pipes should be provided. The objection may be raised that the mixture of alcohol and air may form an explosive compound; but this mixture is made every day and we do not hear of any explosions resulting. It certainly will not increase this danger to provide means of feeding the alcohol regularly into the air line instead of pouring in an excessive quantity and then doing without it for a period.

The accompanying illustration shows a convenient arrangement for feeding alcohol into the air line, which can be built at small expense and regulated to suit the demand. A short piece of 6-inch pipe *A*, capped on each end to make a reservoir, is fastened to a wooden horse *B* by a strap *C;* the reservoir is filled through a valve *D* on the top of the cap. A small pipe at the bottom is provided with a needle-valve *E* to regulate the feed; the valves sold for gasoline torches are suitable for this purpose. As it is necessary to know how fast the alcohol is feeding, means must be provided to observe the flow. A glass like that used in a sight-feed lubricator may be employed, but as this is likely to be broken a better method is to use a petcock *F* as indicated. When this petcock *F* is opened, the drip may be observed and adjusted; then, when it is closed, the alcohol will flow off at one side through the feed-pipe *G*. By using a number of these feeders near the terminals of the branch lines, instead of one large feeder on the main line, some advantages are gained. If this feeder is made of ⅛-inch flexible copper pipe, the connections may be made at any troublesome point without exact pipe fitting, and slight disarrangements will not break the pipe. In the feeder shown, an extra petcock *H* is provided which may be opened when adjusting the drip valve to relieve any air pressure that may accumulate from the leaking of the shut-off valve *J;* otherwise, the unbalanced air pressure may cause the alcohol to drip faster while it is being adjusted than it will when the valve is closed. The small pipe *K* is necessary to maintain the pressure in the reservoir and to admit the air above the alcohol.



FEEDING ALCOHOL INTO MAIN

When it is considered that under bad conditions the machine operators may often waste from 50 to 75 per cent. of their time because of frozen machines, it will be apparent that almost any reasonable expense or trouble that may be taken will be an economical measure if it removes the difficulty. The required amount of alcohol is best determined by test, gradually shutting down the feed to the minimum necessary to prevent freezing. It may be calculated by considering the capacity of the compressor and the degree of humidity, and then allowing about 25 per cent. of alcohol for the water content. Any kind of alcohol may be used. Some other anti-freezing chemicals might be employed, but most of those that are effective have some objection to their use. Any oily substance is injurious to the rubber hose. Alcohol also is injurious, but as it is used only during the most severe weather and quickly evaporates, this objection is not of much practical consequence.

[The above interesting article which we reproduce from *Machinery*, Dec., 1918, seems to invite a word of remark. The use of alcohol for the freezing-up trouble is, as the writer intimates, not infrequent, and the arrangement which he describes seems to be well adapted for the purpose, especially when we are assured that it is an actual success in practice.

The writer, however, does not seem to realize the possibility and the advisability of getting as much moisture as possible out of the compressed air before it is sent into the pipes for transmission. As to getting the intake air as cool as possible there can be no question, but it is intimated in the article that no pains were taken to get the air also as dry as possible, when it is a notorious fact that the driest air that can possibly be found is always saturated and, as we might say, dripping with water, when it has been compressed to the usual working pressure and allowed to cool to normal temperature. When the air is at its highest pressure and by aftercooling is also at its lowest temperature its capacity for moisture will be reduced to a minimum. There must then be a considerable quantity of released water present and this should be separated and drawn off right at the compressor, and then the water trouble will no longer be serious.

DOMESTIC OIL FIRING DEVELOPED IN EGYPT

We reproduce from a recent issue of *The Engineer*, London, some account, with photos, of a successful special oil burner for domestic use which was developed under the pressure of necessity and in an unusual locality.

Egypt, like other countries, has of late been thrown on her own resources, and though she is in the fortunate position of "producer," the fuel problem for domestic purposes has caused considerable anxiety to the responsible authorities.

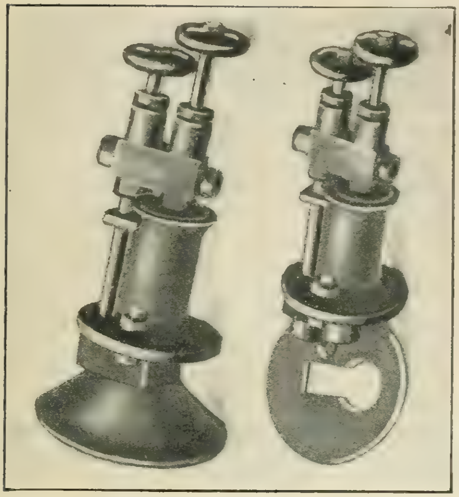
The importation of coal for the civilian population has practically ceased, and without the timely discovery of the Red Sea oil fields, and their development by the Anglo-Egyptian Oil Company, power houses must have come to a standstill. The crude oil is somewhat deficient in the lighter products, but there is a plentiful supply of "mazout," or residues of a heavy viscous nature, and frequent attempts have been made to utilize this heavy oil for domestic purposes without success. Now, Mr. E. C. Bowden-Smith, M. I. Mech. E., of Cairo, informs us that he has recently devised an efficient system of combustion, together with a simple liquid fuel burner, which can be applied to an ordinary kitchen range without structural alteration or interfering with the burning of solid fuel. The essential features are: the use of compressed air as the atomising fluid, induced draught for combustion, the gravitation of the oil, sight feed, and the inability of the burner to choke.

Figs. 1 and 2 are both photographs of the "Scarab" burner, which in this case is provided with a flange for bolting it to a hinged furnace door, and both the oil and atomising fluid, either air or steam, are controlled by regulating wheels. The cast-iron cone is embedded in fire clay inside the furnace. Fig. 3 shows how the burner is attached to the front of a closed kitchen range.

The oil reservoir will be observed raised on a stand, so that a lamp may be set beneath it for initial heating purposes, and the air-supply pipe can be seen attached to the range between the two oven doors. Flexible metallic pipe is used for the connections, as it is of great importance that no uncoupling of nuts and unions should be necessary for cleansing purposes.

The burner itself is of novel but simple construction. It consists of a frame attached to the front of the range, on which is hinged a hollow casing through which passes a pipe terminating in a nozzle for the compressed air. Parallel to this pipe, fixed above the casing, is a similar pipe for the fuel oil, which terminates in a lip precisely over a pin, fixed in the top of the nozzle. The nozzle projects an inch or so into the fire grate, but does not in any way interfere with the burning of solid fuel. A regulating wheel in the burner header controls the oil supply, and in this instance an ordinary 3-8 in. valve (not shown) controls the air supply, as the pressure is constant at 20 lb. It is obtained from the compressed air mains for draining the city.

To start the burner from cold the fuel oil is heated, preferably to 180 deg. Fah. A small fire is made in the grate, of any kindling material. The valves are opened. Oil flows through the upper pipe till it creeps from the lip on the pin, and thence on to the nozzle. The air issues from an orifice in the nozzle, and, meeting the oil at right angles, injects a spray into the fire grate; atomisation and ignition takes place. A fierce draught is induced through the casing, and a continuous flame of dazzling brilliance radiates a steady heat. There is neither smoke nor smell, as perfect combustion takes place, and the only noise is a gentle singing similar to that of a boiling kettle. As the grate and fire bricks be-



HEAVY OIL BURNER

come heated the fire gains in strength, and no difficulty has been experienced in maintaining temperatures for roasting and the heaviest day's cooking on the largest range.

The quantity of oil consumed depends upon the fierceness of the fire it is desired to maintain, and varies from .75 kilo (2 lb.) to 4 kilos. (9 lb.) per hour. From the daily records in actual cooking without any attempt at economy it was found at the Kasr-El-Eini Hospital, Cairo, that 32 kilos. of oil would do the work of 80 kilos. of coal, and the figures for the Turf Club, Cairo, worked out at 48 kilos. of oil to 107 kilos. of coal. Therefore, weight for weight, there is a saving of over 50 per cent.

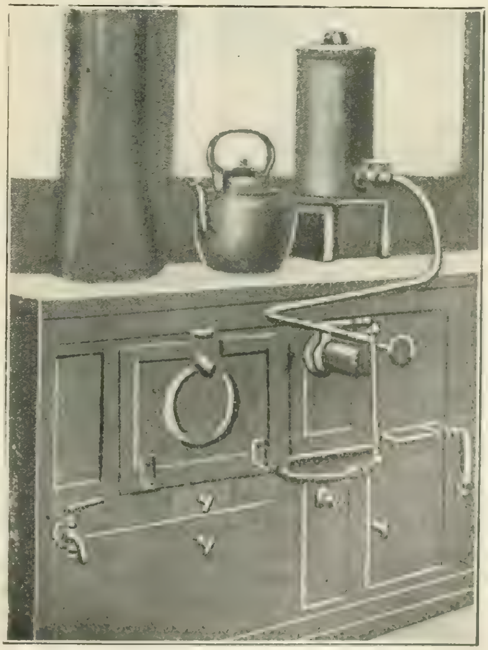
At war prices there is no necessity to lay stress on the enormous saving in the cost of firing. No doubt a kitchen range does not consume coal so efficiently as a steam boiler, but it is obvious this system of oil firing has a very high efficiency. Large burners of this design have also been made for power-house boilers.

The volume of compressed air required for atomisation is by no means excessive. A circular orifice of a certain diameter cannot discharge more than a certain volume of air at a certain pressure. In a small kitchen range, with a working pressure of 20 lb. per square inch, a volume of .119 cubic feet of free air per minute is required. For a large range an orifice discharging approximately .30 cubic feet of free air per minute has been found sufficient. There is little doubt that the induced draught assists atomisation.

CAIRO AIR COMPRESSING PLANT.

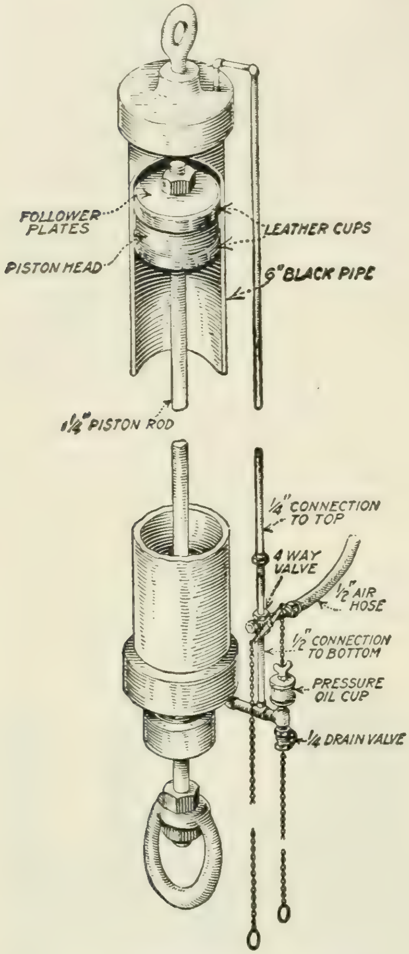
It may be of interest to add here a word or two about the Cairo compressed-air installation. It is a large one, comprising four sets of triple-expansion steam air compressing engines, and each engine is capable of compressing 2,000,000 cubic feet of free air per day (24 hours) at a pressure of 22 lb. to the square inch, which gives a working pressure of 20 lb. per square inch in distant localities. For the year 1916-1917 the volume compressed was 573,240,000 cubic feet of free air, at a total maintenance cost of £E.6.878.976, or six thousand eight hundred and seventy-nine pounds in round figures. This equals a cost of £E.0.012 (3d.) per thousand cubic feet of free air compressed. The cost may be a little more at the moment, but very much less in normal times. At present, to raise the sewage under normal working conditions does not absorb more than the output of a single engine.

There are 28½ miles of cast-iron main distributed over the city, and it is obvious that thousands of rateable houses are in a position to derive the immediate benefit of cheap power



BURNER APPLIED TO STOVE

for combustion, and at the same time reduce the costs of maintenance of the compressed-air installation.

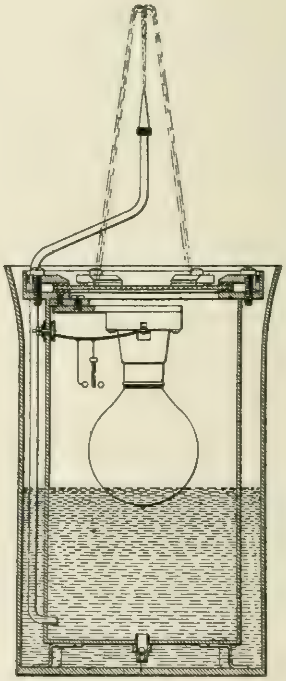


A HOMEMADE AIR HOIST

The cut here reproduced from a recent issue of Coal Age shows a handy air hoist that can be made at almost any mine shop or elsewhere, and it can be employed to good advantage.

The drawing is almost self-explanatory. The hoist cylinder, or barrel, is made of a piece of ordinary 6-in. pipe. The piston is constructed of three disks and two cup leathers faced in opposite directions, the whole being held firmly together between a collar on the piston rod and a nut on the end. The admission and release of air is controlled by a suitable cock operated from the floor by means of suitable hand rods. The length of the hoist cylinder and travel of the piston may be made to suit local requirements. One hoist of this kind that has been in successful operation for some time and has proved itself a great time saver is made with a lift of 4 ft. 6 in. With a 6 in. barrel as here shown and 80 lb. air pressure it will lift one ton.

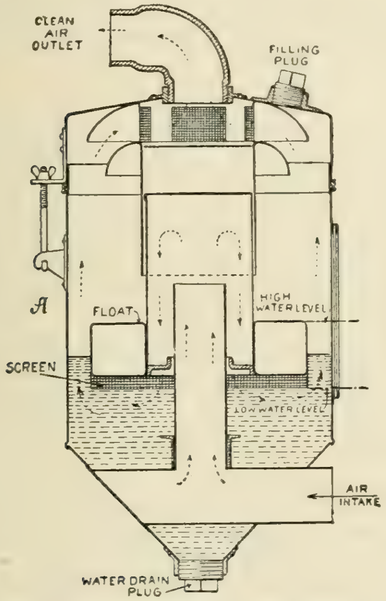
In operation such a hoist as this may be mounted upon a jib crane or a track suspended either permanently from the roof trusses of the building or from a frame in the repair yard, or it may be hung from a chain or eyebolt if horizontal movement is not necessary. Such a device as this may be constructed at small expense, and in many instances, at least, will not only be found highly convenient, but also prove itself a time saver of appreciable value.



AN AIR OPERATED ELECTRIC FOUNTAIN

The neat and simple electric fountain shown in the sketch might not at the first glance be regarded as a compressed air proposition, but such it certainly is. A 150 watt Mazdo lamp is placed in the upper part of an airtight vessel partly filled with a liquid, say perfumery, to be sprayed. The tube at the side is open to the liquid near the bottom and its upper end is a nozzle of capillary dimensions. The heating of the air by the lamp develops a certain pressure which acting upon the liquid drives it up the tube and out of the nozzle. When the current is turned off the air pressure falls and the liquid collected at the side returns to the inner vessel through a check valve.

This fountain is the invention of Matt. Luckiesh by whom it was recently patented and assigned to the General Electric Company.



AIR WASHER FOR TRACTOR

A tractor usually operates under conditions that produce a cloud of dust about the mechanism and unless special precautions are taken the air inspired into the carburetor is apt to be full of dirt and grit which not only promotes deposits in the combustion chamber interior but also causes considerable mechanical depreciation. An improved type of air washer is shown in the cut here reproduced from the *Scientific American.*

This is the type in which the air is passed through a water chamber and actually washed before it is sucked into the engine. Of course, water will be used up in this process, so a float controlled stack insures that all air must pass through the water as indicated by the arrows. In addition to the water, the air must pass through screens as well, so the water that may be present in the form of globules is effectively broken up and no dirt can be drawn into the engine. This insures clean, moist air, very desirable for engines using kerosene carburetors, and also reduces scoring of the cylinders and wearing of the rings of the piston. A glass water gage is provided so the operator can make sure there is an adequate supply of water at all times.

AN AIR SCREEN FOR FURNACE WORKERS

Workers tending furnaces, and required to examine the glowing material at frequent intervals suffer a great deal from the heat radiation, and various devices have been tried for minimizing the ill effects. For example, hollow water cooled furnace doors have been tried, but they only afford protection while they are closed. Again, devices have been installed for drawing off the hot air in front of furnaces by centrifugal exhausters placed in front of the furnace opening. An objection to these is that the workers are subjected to great variations in temperature prejudicial to health. A recent article in a German publication states that the most effective device is the fixing immediately behind the furnace door of a narrow oblong nozzle through which cold air is blown upward, thus interposing a screen of relatively cool air between door and furnace. This arrangement is stated to give adequate protection to the workers, and has the incidental advantage that when the doors of the furnace are opened the escape of flames is checked.

GRADING SMALL COAL BY AIR CURRENT

The grading of fine coal by means of a powerful current of air is an interesting departure, which may well have considerable possibilities, especially as the dust taken out by such method will be comparatively free from substances of higher specific gravity of coal.

At a North Country colliery where a grading plant has recently been installed by Messrs. Matthews & Yates, the coal is delivered to the washery by a bucket elevator, and discharged on to shaking screens. The grading apparatus is fixed immediately under the delivery shute of the elevator, the mixed coal being allowed to flow over a hinged weir plate. Immediately under this plate is an orifice through which a powerful current of air is drawn by means of a centrifugal fan. The size of the opening is capable of adjustment by means of a sliding plate. The passing stream of coal is brought nearer to or kept further from the suction by adjusting the hinged weir plate, so that any desired proportion of small coal can be drawn off. A deflecting plate is fitted into the receiver, which serves to throw the larger pieces of coal to the bottom; the fine dust, passing on with the air through the fan, is finally collected in cyclone separators. These separators, which are of the cyclone patent multiple type, are fixed over the briquetting plant, some distance from the washery. The fines are made into briquettes, which is certainly the most satisfactory method of disposing of the fines coal.

The alternative methods of feeding the fines coal, either dry or in the form of slurry, on to the washed coal are at best clumsy and unsatisfactory. Assuming, as indeed is often the case, the whole of the fines made are used for steam-raising at the works (in which case they can only be fired in the form of a semi-wet slurry), their increased steam-raising capacity if fired in the form of briquettes would fully justify the initial capital outlay on the plant. It need hardly be pointed out that fines for conversion into briquettes must be recovered in a dry state.

In the plant under notice the washery is dealing with 1,000 tons of small coal per day of 10 hours. The exhauster is belt-driven, and has an inlet 22 in. in dia., with an outlet 16½ in. by 23 in. It runs at a speed of about 1,100 r.p.m, and is extracting approximately 12,000 cub. ft. of air per min., the total power absorbed being 15 b.h.p.

The coal is graded into three sizes. All above ⅛ in. falls past the opening (No. 1 Coarse). Below ⅛ in. is deposited in the receiver (No. 2 Medium), and the dust deposited by the separator (No. 3 Fine).

We append results of tests made on various different qualities of coal. The first series has been air-graded from South Yorkshire coal, the mixed coal ranging from 0 in. to ¼ in. The results on this sample were as follows:

Test No.	Fan speed r.p.m.	Angle of weir plate with vertical.	Percentage of coal, No. 1 Coarse.	Percentage of coal, No. 2 Medium.	Percentage of coal, No. 3 Fine.	Percentage of loss.
1	1,400	45	69.5	20.6	8.5	1.4
2	2,800	45	61.9	24.4	13.5	0.2
3	2,800	20	49.4	33.1	17.2	0.3
4	3,400	30	34.0	43.0	23.0	—

The second series of tests, on a Welsh coal, varied as follows:

Test No.	Fan speed r.p.m.	Angle of weir plate with vertical.	Percentage of coal, No. 1 Coarse.	Percentage of coal, No. 2 Medium.	Percentage of coal, No. 3 Fine.	Percentage of loss.
1	1,500	45	96.0	1.5	2.2	0.3
2	1,500	20	91.0	5.5	2.8	0.6
3	2,600	20	86.5	9.1	4.4	—
4	2,800	45	89.0	6.3	4.7	—
5	2,900	10	82.5	9.1	8.1	0.3

In each test a small quantity of coal was put through an experimental plant, and the weights of the three different grades of coal noted. It will be observed that the speed of the air current was gradually increased, and by adjusting the damper the amount of small coal removed varied from 4 to 17½ per cent. The sample of the original mixed coal in the last series of tests was from 0 in. to 1⅛ in.

HOSE MOUNTING AND HOSE CLAMPING MACHINE

The illustrations on opposite page show a hose mounting and hose clamping apparatus devised several years ago by and for the use of the Westinghouse Air Brake Company. The company has not heretofore manufactured these devices except for its own needs, but it now has so arranged that they may be procured upon order, either as complete outfits or merely such details as cannot be supplied from existing railroad material. These can be ob-

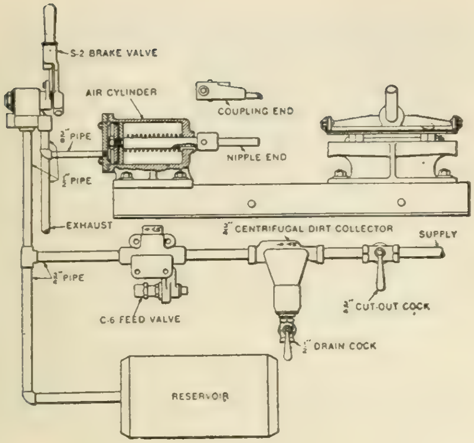


FIG. 1

tained from the company or made to blue prints which will be furnished on request.

HOSE MOUNTING MACHINE.

Referring to Fig. 1 it will be observed that the hose mounting machine consists of a Z-bar frame on which is mounted a hand operated clamp, designed to grip the hose throughout the greater part of its length so as to hold it rigid while the coupling or nipple is being applied; a compressed air cylinder; an operating valve for controlling admission and exhaust of the air from the compressed air cylinder, and accessories including a reservoir, C-6 feed valve and cocks.

The piston rod of the cylinder is adapted to the special heads used for mounting the coupling or the nipple. These heads are removable so that both the nipple and coupling can be mounted on a single machine, although not at the same time.

The operation of the machine is essentially as follows: The hose is placed in the hand operated clamp. The shank end of the nipple or coupling, before being placed on the head, is dipped in rubber cement which acts as a lubricant and also serves to make an air-tight and rigid joint. The clamp is then drawn down to hold the hose rigid; the handle of the operating valve is moved to application position admitting air to the cylinder, causing the piston and rod to move out and forcing the shank end of the nipple or the coupling into the hose. The handle of the operating valve is then moved to release position in which the air is exhausted from the cylinder and the piston and rod returned to normal position. The clamp is then released and raised, allowing the hose to be removed.

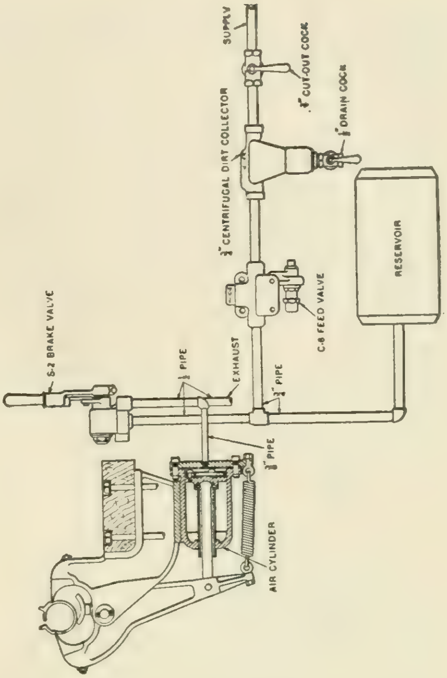


FIG. 2

When all of the couplings have been applied to one end of the hose, the head on the cylinder piston rod is changed and the nipples applied to the other end of the hose in the same manner.

HOSE CLAMPING MACHINE.

The hose clamping machine shown in Fig. 2 consists of two hardened steel jaws, one of which is movable, a compressed air cylinder, the piston rod of which is connected to the movable jaw, a tension spring attached to the lower end of the movable jaw providing for the opening of the jaws when the air pressure is released, an adjustable support to provide for the various sizes of hose used (to be lowered for the larger sizes and raised when applying the clamps to the smaller sizes. This is important, as the points of the jaws must properly engage the shoulders of the clamp to avoid pinching the hose), an operating valve and a feed valve, together with the usual reservoir and accessories such as cocks, etc.

After the coupling and nipple have been applied, the clamps are first loosely strung on the hose. This is readily accomplished by kinking the hose to permit of slipping on the clamp through the opening between the lugs. The hose is then laid on the support and the clamp placed in position by hand. (It is important that the clamp be between the end of the hose and the bead on the shank of the coupling or nipple and *not on the bead.*) The operating valve handle is moved to application position admitting air to the compressed air cylinder, forcing out the piston and rod and causing the jaws to close, gripping the clamp just back of the shoulder, closing it and holding it closed while the bolt is applied and the nut run up on the bolt until it comes tightly in contact with the lug on the clamp. The pressure is then released by moving the handle of the operating valve to release position, the hose turned end for end and the same operation repeated.

WOODROW WILSON AIRWAY

The Woodrow Wilson Airway across the continent from coast to coast, has been completely mapped, and these maps and report made by the compilers, Henry Woodhouse, president of the Aero Club of America, and Captains Russell Hastings Millward and Robert A. Bartlett, the famous explorer, will be published in the Aero Blue Book issued by the Century Company. The map of the transcontinental airway comprises 17 sections between New York and San Francisco and cost $6,000 to compile, exclusive of printing.

This first transcontinental air-lane was laid out in anticipation of through flights between the two oceans, both for training and military purposes, as well as for ultimate airplane mail delivery. The route was named the Woodrow Wilson Airway after President Wilson signed the $640,000,000 appropriation for army aeronautics last year.

This first transcontinental airway follows very closely the line of the Lincoln Highway between New York and San Francisco, deviating therefrom only where conformation of the country forces road detours from a straight line, which are not necessary, of course, to aeroplanes.

The airway zone extends 40 miles on each side of the airline and touches the most important cities in New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Iowa, Nebraska, Wyoming, Utah, Nevada and California. Any city or community in this 80-mile zone will be designated as being on the Woodrow Wilson Airway. The zone is laid out to make it possible for any air traveler to reach the extreme part of either side of the zone in half an hour's flying. It is planned to arrange for landing places for aircraft and identification marks in the important communities in the direct line of the airway and at the approach to every community.

The proofs of the Woodrow Wilson Airway maps were delivered from Washington to New York by air post.

The route is a curve rather than a straight line, as it follows the great circle of shortest distance as ships do at sea, taking into consideration the curvature of the earth.

The maps of the Woodrow Wilson Airway show not only all transcontinental rail connections, but also the Lincoln Highway, various communities along it, and the location of weather bureau stations, magnetic declinations, etc. A complete chart of all elevations between the two coasts is included.

AIR CLEANERS

Although it has been well known for years that the grit drawn into an engine through the carburetor, with the air required for the combustion of the fuel, is largely responsible for the wear of cylinders and pistons no serious attention has been given to the subject until quite recently, when the Government specified an efficient air cleaner on its war trucks—although such a device hardly existed. This action has had a very salutary effect in a much needed direction. The interest in farm tractors has also had a great deal to do with stimulating the invention of a satisfactory air cleaner, for it was found that the great amount of dust stirred up by a farm tractor in its ordinary work had such a serious effect on the operation of the motor that action by the makers was necessary. Now the problem is being taken up actively, and we may expect that all future farm tractors will be properly equipped, and the device will probably constitute a strong "talking point" in the sale of trucks. Whether it will appear soon on the general (*ne* pleasure) automobile will depend largely on whether buyers insist on it. It certainly would be more desirable than some of the showy accessories now used to attract the attention of the public.—*Scientific American.*

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MAGAZINE

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THE OUTLOOK

Far different is our outlook on this New Year from that of a year ago. The change which came over the world, although so sudden, was still so great as to suggest by contrast a lapse of a century rather than a single year. Then it was war of frightfulness and atrocity unparalleled, and with, as we must now confess, great uncertainty as to the outcome. Now it is peace with no possibility of a renewal of the horrors which did so beset us, but still not without its uncertainties as to the ultimate stabilization.

The one thing we know for a certainty is that things in our nation and in the world can never again be as they were. We cannot go back to the old days or the old ways. We think we are now to have peace and therefore rest. There may be these who would even be singing—

> "Now will I bathe my weary soul
> In seas of heavenly rest
> And not a wave of trouble roll
> Across my peaceful breast,"

but nothing of that kind is within the possibilities.

We have entered upon a time of great responsibilities and of great opportunities. Instead of peace and quietness it is a strenuous life that opens before us, and we shall need for it special preparation and adaptiveness. The war it is impossible to forget, and it is difficult for us to avoid still thinking along war lines notwithstanding that these lines have latterly been so diverted from their original parallels.

So far as we must think of providing the weapons and appurtenances of war as still essential for policing the world and for reciprocal protection it will be well to make haste very slowly in view of the changes, the advances if you please, in the means and methods of destruction which the war brought about. Three distinct and most efficient and successful of all human death dealing devices came into action for the first time, and only one of them, the U-boat, gave the world an idea of what it is capable of doing.

Of the employment of blinding, asphyxiating gases in warfare, the second of the novel offensive devices, it is not necessary to speak here. If used in sufficient quantity, and by nations that will not fight according to the rules of the game, it presents another serious problem.

But the third of the war developments, the airplane as an offensive, is perhaps the most serious of all to deal with. It is easy to believe that it may prove a far greater terror than the U-boat. It is still in process of development and its possibilities still await demonstration. It can go any where and its comings and goings cannot be traced and its location at any instant cannot be anticipated. Its ability to carry enormous weights of high explosives is now almost unlimited and it can operate in masses flying so high as to be little likely to be hit. Our large cities are entirely at its mercy if humanity does not restrain it. To attack naval vessels by this means may be perfectly legitimate warfare, and the question arises at once as to the wisdom of building big ships of war that can now be attacked both from above and from below, and especially the former.

It would seem that at the present time we might be far more profitably employed than in thinking and planning war whether offensive or defensive. Even for the latter service it will be most profitable to forget it until we can get an accurate survey of all the possibilities which the war activities have developed, and in the meantime the arts of peace are open for the profitable employment of many of the war time devices.

FUTURE OF THE AIRPLANE

The following is from an address by G. Douglas Wardrop, editor of Aerial Age, who has recently returned from a trip to the front.

Most people are familiar with the part that areoplanes have played in the war, although their application at the front up to the time of signing of the armistice was nothing compared with the veritable cloud of planes which would have flown over German territory in the Spring of 1919 and literally blown the German from the sky.

The layman has not given as much thought to the future as developments warrant, inasmuch as no work along commercial lines could be done during the continuance of the war. But the following facts are interesting as showing what we may expect within the next year or two, or even within the next few months.

Mr. Wardrop told the guests that at the time he left England he saw a bombing plane capable of carrying a load of 4700 lb. of bombs. He saw another one which was destined for the Berlin route in 1919 which carries 42 passengers.

Trans-Atlantic trips, he says, will be made, without doubt, this coming year, and within the cycle of 24 hours. There is building in Italy an enormous trans-Atlantic cruiser with an engine of 18,000 hp., beside which the 42-passenger plane would look like a pigmy. A cruiser as larger as the Italian cruiser is being built in this country, and it is a sporting competition to see what country will first make the trans-Atlantic record.

A London newspaper was planning to open a Paris office after the war, but has now discontinued these plans, for it will be possible to print a Paris edition in London and deliver it by aeroplane in an hour or two, saving the vast expense of a Paris printing plant.

There is an aeroplane manufacturing company in England that is seeking to contract with the Government for 5 years to carry all first-class mail matter at the present first-class postage rate.

In our own aerial mail program, he said that within a few days after his address was delivered, letters would go from New York to San Francisco within a period of 48 hours.

Another thing which is almost completed at the end of the war and which will, no doubt be a success, is the construction of an aeroplane so that it can hover in one spot or nearly so.

These and many other interesting things that he told show that the last of the three great elements with which man contends has practically been conquered and that it will be but a few years before full commercial developments will have been attained.

Natural gas valued at $9,000,000 was wasted in one year in a certain group of cities and towns in Kansas and Missouri, according to figures compiled by experts of the United States Fuel Administration.

The Traylor Cement Gun Construction Co., Allentown, Pa., organized by S. W. Traylor, president Traylor Engineering Co., will build a plant in France for the manufacture of the Traylor cement gun, to be used in reconstruction work in that country.

GERMANY'S STOLEN CHEMISTRY

The *Mining and Scientific Press* for September 28 contains a breezy and refreshing article by Towne R. Leigh with the above title. He says: "When we recall that Samson slew a thousand Philistines with the jawbone of an ass, we intuitively wonder how many he would have slain if armed with the jawbone of a German propagandist, according to whom all things were made by Germans, and without whom was not anything made that was made. . . . It is time to prick the inflated bubble of Germany's chemical reputation. Glancing down the index of a leading chemical textbook, my eye rests upon the word 'Law,' followed by a list containing 21 fundamental laws by which the science of chemistry is governed. There I see the names of Avogadro, Boyle, Charles, Dalton, Dulong and Petit, Faraday, Gay-Lussac, Henry, Lee Chatelier, Mendelejeft, down to van't Hoff—but nowhere do I see the name of a German."

A LAUNDRY DRIES FRUIT

Since it was discovered that the drying facilities of the laundry could be utilized for drying vegetables and fruit, Manager Jay Davison, of the Northfield Co-operative Laundry, has been swamped with this extra business, which means much extra night work. The vegetables and fruit handled were principally corn, beans and apples. Everything is prepared before it is brought to the laundry, where it is placed on large trays holding about ten pounds each. The capacity of the dryer is about 150 pounds. The trays are placed in the dryer at night and removed in the morning. Steam must be kept up for a while during the evening, and the caretaker must be on hand for a few hours to look after the fruit or vegetables, so they will dry properly.

JACKHAMERS CUT AN OLD PAVEMENT

A trench for a new street railway track in Chicago was recently cut through an 8-in. concrete base at the rate of about 200 ft. per day. The plant and force employed consisted of a portable drilling outfit, a revolving steam shovel, and two gangs of jack and bar men. The cut was 20 ft. wide along the center of the street, and was made after the wood-block paving had been removed.

A portable air compressor, operating four jackhamer drills, led in the work. Holes about 6 in. apart and 1 in. in diameter were drilled through the base. First, a row of holes was drilled on each side of the cut; then, transverse rows, 6 or 7 ft. apart were put through the strip to be removed. Two gangs of bar and jack men followed the drillers, breaking up alternate 75 to 100 ft. sections of the slab. Each gang broke out the concrete in transverse sections, corresponding in width to the space between the transverse rows of drill holes, and threw the fragments behind.

By use of two or three ratchet jacks with a hold under the edge, the base slab was lifted until it cracked into pieces of one or two square yards, with smaller pieces. Men with bars pried the slabs apart, and others using heavy two-handed sledges broke the larger pieces into sizes which would pass a ½-cu. yd. steam-shovel dipper. Pieces which failed to break from the edges of the cut were wedged free with steel points sledged into the drill holes. The steam shovel followed the rearmost breaking gang and loaded the broken concrete into dump wagons for disposal. The work was done for the Chicago surface lines.—*Eng. News-Record.*

CROSS COMPOUND COMPRESSORS ON LOCOMOTIVES

The following is an abstract of a report prepared by a committee of the National Air Brake Association and presented at the recent annual meeting. It will be seen that it deals exclusively with type of compressors attached to steam locomotives for air brake service.

LOCATION AND INSTALLATION

Cross compound compressors should always be located on the left side, forward of the staybolts. While the design of the locomotives will to a certain extent determine the exact location, a place entirely below the running board and as near the rear of the boiler barrel as possible is to be preferred. A large opening and free passage strainer should be installed in a vertical position and secured to a substantial bracket. It should be located so as to be free from dirt thrown up by the driving wheels and where it will not be exposed to escaping steam. The two suction openings from the compressor should be piped together with 2 in. pipes and a pipe of similar size then extended to the strainer.

The oil pipe connection to the steam pipe should be between the main steam valve and governor. With a two-compressor installation difficulty is sometimes experienced in lubricating the steam ends of both compressors, due to unequal distribution of oil. To facilitate this the 1½ in. main steam pipe should enter horizontally into the side of a 1¼ in. by 1¼ in. by 1½ in. horizontal tee, located adjacent to and above the compressors. From this tee two 1¼ in. branch pipes of equal length should extend to the compressors.

LUBRICATION.

When starting the compressor the piston rod swabs should be lubricated with valve oil, the throttle opened gradually and the compressor run slowly until all condensation is worked out of the steam cylinders, then the drain cocks should be closed. All drain cocks are to be opened, and left so, when compressor is stopped at terminals. While the compressor is yet working slowly, 10 to 15 drops of oil should be fed to the steam cylinders and 8 to 10 drops to each air cylinder. After obtaining about 40 lb. pressure the throttle can be opened.

The air cylinders should be lubricated regularly, four to six drops, how often depending on the service, but never over six hours apart in heavy freight service, and especially just before starting down a mountain grade. With cab air cylinder lubricators, which are superior to the hand oilers, never attempt to adjust to feed continuously, as the slowest possible regular feed will be excessive.

There has been considerable criticism regarding the use of superheat oil in the compressor air cylinders, the general impression being that it is too heavy, tending to more quickly clog the passageways and packing rings. While it is conceded that better results may be obtained with Perfection valve oil, yet where the special 54 air strainer is employed no trouble is experienced from the use of superheater oil, thus indicating that the gumming with it is mainly due to dirt.

Dirt entering the air cylinders destroys lubrication and increases the wear of packing rings and cylinder walls. The dirt and worn-off metal form the hard gum so frequently met with; hence, the exclusion of dirt will improve the lubrication and reduce the wear and gumming.

COMPRESSOR LAUNDRIES

A very effective and economical way to remove this deposit is by means of the compressor laundry, which should be used every three months or longer, depending on the service and protection afforded against dirt. Compressor laundry outfits consist in general of an enclosed tank mounted on wheels, for a lye solution, a steam coil inside the tank and suitable pipe connections to join the tank to the suction and discharge openings of compressor. The solution should consist of about one lb. of concentrated lye to one gal. of water, and should be kept hot by steam circulating through the coil while the compressor is being laundered.

[A description of compressor laundries of the type here referred to will be found in *Compressed Air Magazine,* August, 1918, page 8846,—Ed. C. A. M.]

The length of time the compressor should thus operate depends on its dirty condition, but usually from two and one-half to three hours gives the best results. After the compressor has been thoroughly cleansed the tank connections should be removed. Clean water (hot water is preferable) should then be worked through the air cylinders for several minutes, discharging into the pit, to insure all of the solution being removed, after which the compressor should run idle until all the water is worked out of the cylinders. The air cylinders should then be well lubricated, the strainers applied and the discharge pipe connected. If soft packing is used the air end may need to be repacked. A solution of about 10 gal. will be sufficient to cleanse about five compressors.

Insufficient lubrication, especially in the steam end of the compressor, is one of the most common causes for the compressor running slow. On roads where valve oil seems to be at a premium, either by an oil schedule or otherwise, the air compressor is usually the part that is stinted to make an oil record. At the normal cost, of about 55 cents per gal., for oil it will cost 5 cents per 16-hour trip to properly lubricate both ends of the compressor.

Other causes for the compressor running slow are worn packing rings in the high-pressure air cylinder or clogged passages in the air cylinders. No trouble will be experienced with the latter if the compressor laundry is used as herein recommended. The compressor will pound or make irregular strokes from causes such as main steam valve dry, packing rings in low-pressure air cylinders badly worn, piston rod packing blowing, clogged air passages, air valves with improper lift or leaking and too much oil in the steam cylinders in combination with close throttling by the steam valve or governor.

The compressor will give good service when the low-pressure air piston packing rings are worn until 3-32 in. to 5-32 in. open. The latter should be the limit.

A slow upward stroke of the low-pressure air piston may be caused by a restricted air passage between high and low pressure air cylinders, or top steam cylinder gasket leaking to the top side of high-pressure steam piston, or high-pressure air piston packing rings leaking, though if the latter were at fault the low-pressure air piston would move slowly in both directions. If the high-pressure air piston makes a quick downward movement and the low-pressure air piston a quick, upward movement, the cause may be on account of a lower intermediate valve leaking or held off its seat. If the quick movements of the pistons mentioned are in the opposite direction than stated, the cause may be from an upper intermediate valve leaking. If the high-pressure air piston only makes short strokes, and compressor will not maintain more than 45 to 60 lb., it indicates discharge passages badly clogged, or final discharge valve leakage.

When a compressor gradually keeps reducing in efficiency until it does not maintain standard pressures under relatively favorable conditions, the trouble is usually due to worn and leaking high-pressure air piston rings. Under these conditions the low-pressure air piston will be working against more than its normal pressure. Low speed can also result from steam cylinder gasket leakage, and if leaking between ports of high and low pressure cylinders, or between low-pressure cylinder and exhaust, it can be located by a continuous blow at the exhaust, providing the exhaust pipe is disconnected close to compressor and the latter run slowly. If the compressor has been maintaining standard pressures, and in a relatively short time does not, the trouble is undoubtedly due to some foreign substance lodging under an intermediate or discharge valve, thereby causing serious leakage. Such foreign substance can at times be removed by closing compressor throttle and brake valve cut-out cock, draining all pressure from main reservoirs, after which run the compressor fast for a few minutes. After the main reservoir pressure is restored, open brake valve cut-out cock.

AN A. C. MOTOR AND A LITTLE OIL

A stone cutter, who used considerable compressed air for pneumatic hammers, had the compressor overhauled and a new automatic starter for the electric motor installed. The motor was a single-phase 220-volt self-starting squirrel-cage clutch type, belted to the compressor. In this type of motor when the circuit is closed the rotor starts to revolve, and when it has attained sufficient speed the clutch takes hold and starts the compressor. When tried for the first time the motor started, but when the clutch took hold the motor stalled because the compressor would not start. Several men tried to help by turning the flywheel, but without success, and unless the man operating the switch was very careful the fuses would blow.

As the starting box was the only new part (the motor having driven the compressor for over two years previously), naturally it was thought to be the cause of the trouble. An ammeter and voltmeter were connected in the circuit and showed the motor to be overloaded when starting, but after the compressor was started the motor was well able to carry its load.

A clicking noise heard at the back of the compressor proved to be coming from the unloading device, supposed to prevent the air pressure from rising in the compressor until the motor was at full speed, but it was not working properly. After this device was oiled and adjusted, the motor started easily every time.—*A. Rathron, in Power.*

GAS TRANSMISSION IN WELDED PIPES

By W. M. Henderson

The distribution of gas is usually accomplished by large mains under low pressure, though the rapid development of rural territory and the spreading out of municipalities have prompted the adoption of high-pressure transmission and distribution to quite an extent.

The usual practice is to distribute gas through cast-iron pipes under a pressure varying in different communities, but generally about six or eight inches of water. Higher and lower pressures are occasionally varied.

The distribution system is laid out originally with a view to maintaining a constant pressure throughout the system. This is accomplished by installing large enough pipes from the works outlet to a point beyond the center of distribution, radiating out from which are pipes of reduced size. These pipes are connected wherever possible; the ideal system in this way would have no dead ends. It is always the object of the engineer in designing the distribution system to build with the idea of taking care of the peak-hour demand. That is, the pipes must be of such size as to care for the maximum momentary demand without apparent drop in pressure. This point is quite important, for in some communities where the load is entirely domestic, there is a great "pull" between 11.30 a. m. and 12 m. or 5 p. m. and 6 p. m. The size of main pipes must be such that they will supply this demand without a pressure drop so great as to affect the gas-consuming equipment.

LUBRICATING AN AIR COMPRESSOR

The two letters following we reproduce from a recent issue of *Power*. The second letter in which the writer found that two drops of oil per minute gave satisfactory results, suggests an inquiry as to why he did not try one drop a minute.

After reading some time ago that water was good for helping to lubricate the cylinder of an air compressor, we decided to try it. We had just installed a compressor and were having considerable trouble with the valves carbonizing and getting hot.

We connected an oil pump to the air cylinder, filled it with water and fed a few drops of water per minute to the cylinder.

We have had no trouble with the valves carbonizing or getting hot since and it is a great saving in oil. The compressor works as well with one-third less oil.

Manassas, Va. R. A. Williams.

A 20x16-in. air compressor running at about 155 r.p.m. had been getting an unknown quantity of oil, but wishing to know how little would be enough, I adjusted the feed to barely two drops per minute and after running about a week inspected the cylinders, which I found to be thoroughly lubricated and in good condition. The gravity of the oil used was 27.3 Baumé.

That the compressor had previously been getting too much oil was evidenced by the fact that we recovered about ten gallons from the receiver. R. McLaren.

St. Catharines, Ont., Canada.

THAWING DYNAMITE

Dynamite is both combustible and subject to explosion from a heavy shock or concussion. Such being the case, it would not make safe kindling wood for the kitchen stove. Neither would a man drop it from a second-story window on the pavement any sooner than he would his watch or his eye glasses. As a rule, any ordinary heat that does not injure the human body is perfectly safe from the dynamite viewpoint. The low freezing dynamites are not affected by cold at a temperature above that at which water freezes, but will chill at lower temperatures.

When frozen it is more insensitive and may give trouble by failing to explode; hence it should be thawed before using. Several instances have been known where frozen dynamite has been laid on top of a hot stove or in the oven with disastrous results to the stove, and somewhat damaging effects on the unenlightened individual who attempted to do the thawing in this manner.

Probably the best method of thawing small quantities is to have two metal vessels, one fitting loosely into the other, or a specially constructed double compartment kettle. The outer vessel or compartment should be filled with warm water, while the dynamite is placed in the inner compartment, where it is dry, and allowed to thaw. The practice of placing the dynamite cartridges themselves directly in the warm water is questionable, for instances have occurred where some of the explosive ingredient has been leeched out—*Pit and Quarry.*

JOINTS IN HIGH PRESSURE PIPE

The only successful type of joint for high pressure is no joint at all. That is, welding by oxy-acetylene the butt ends of the wrought-iron pipe. This idea was developed by Mr. L. B. Jones of this company,* a little over five years ago; today it is *exclusively used and has proved itself so satisfactory that no substitute is even given a thought.*

The pipe for welding is purchased with chamfered ends, and so when butted together a V is formed. The welder works on top of the ground alongside of the trench. With the oxy-acetylene torch and a stick of wrought iron he proceeds to heat the pipe-ends and melt the stick of iron which builds up on the pipe ends. He goes completely around the pipe; usually the pipe is turned as it is more convenient to make the joint upside-down. Practice in this work only makes perfect. The things to avoid are learned by observing cause and effect and very soon the welder becomes perfect and joints are made as strong as the pipe itself.

The entire system of gas distribution at the recent Panama-Pacific Exposition in San Francisco was through pipes with welded joints. The gas supply to the Redwood District is through an 8-inch high-pressure line thirty miles long, every joint of which was welded. Between Santa Rosa and Petaluma there is over twelve miles of welded pipe. In Fresno, Sacramento, San Rafael, Oakland and San Francisco every bit of high-pressure laid in recent years has been welded.

NOTES

A prominent tank manufacturer passed a compliment to the durability of wood in tank work, by advising metal tanks for temporary use and recommending cypress tanks for permanent structures. It used to be that we associated permanence with metal, but now we are learning that metal has its life limits and often wood is more durable.

A postal tunnel about 1¼ miles long, from Grand Central Terminal to Pennsylvania Terminal, New York City is contemplated by Postmaster General Burleson who estimates the cost of construction at $1,125,000 and has asked for an appropriation to build and equip it.

Steel smokestacks 12 ft. in diameter and 125 ft. high in a Chicago power plant were razed by cutting through the base, just above roof level, with the oxy-acetylene flame and then jacking at one side until they fell over. The hopper bottoms of the steel coal bins were also cut off by the flame and allowed to fall to the ground; the headers of the 500-hp. water tube boilers were cut off in the same way and jacked out. The 35-ft. diameter flywheels were easily cut up and their 36-in. shafts were cut into three pieces.

The utilisation of water power in France has increased by more than 50 per cent. since the commencement of the war, and by the end of 1921 the available water power will be double the amount installed at the outbreak of the war.

The Allied countries produce most of the gold of the world, the British dominions and the United States contributing about 85 per cent. of the total. Russia normally yields 5 per cent.

I am as adverse to "scientific management" as I am to scientific employment. The whole theory of scientific management is essentially foreign to the human element and is destructive of individualism and therefore of propress. Pride of work, not pressure, keeps production at top speed. I hold it to be inhuman to work men as though they were machines; in addition to being inhuman it is bad business.—John North Willys, President of the Willys-Overland Company.

The astonishing increase in the production of aluminum can be judged from the fact that while the world production in 1913 was 68,000 tons, experts estimate the production for 1917 at 136,000 tons, for 1918 at 230,000 tons, and for 1920 at 350,000 tons.

The greatest advantage claimed for the cost plus system is that on urgent work it permits work to be started without waiting for the plans to be compleetd, thus effecting a great saving in time, and also probably in cost, as an efficient contractor, working with an architect or engineer, can no doubt make suggestions that will save money as well.

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*Pacific Gas & Electric Company.

In the aircraft standards published by the International Aircraft Standardization Committee while it was sitting in Washington last winter, all dimensions, stress allowances, etc., are given in both inch and metric units, but whereas many of the English dimensions are in round figures all the metric dimensions are in three-place decimals.

A channel tunnel scheme is in project for Japan. Permission has been applied for to construct a tunnel under the Shimonoseki Straits, connecting Kyushu with the mainland. The length of the tunnel would be about six miles.

The Australian chemists claim to have discovered a process for the manufacture of a fast dye from a by-product of eucalyptus oil distillation, known as "black-water." Nearly eighty colored dyes have already been produced by the experiments and patents are being applied for.

We have adopted in our own correspondence a little piece of economy which may appeal to others. On letters to which no reply is necessary, save as a matter of courtesy, we write "National Economy—No acknowledgment of this letter is expected." Every one knows how much time is wasted and paper and stamps used on unessential correspondence. By this means some economy is effected. We suggest that large offices might use printed slips or rubber stamps for the same purpose.—*The Engineer.*

Not only the plurality but also the majority contributor to the world's supply of petroleum is the United States, which furnished 64.74 per cent. of the estimated total for 1917. The others were: Russia, with 13.26 per cent.; Mexico, 11.37; Dutch East Indies, 2.74; Rumania, 2.08; India (Burma and Assam), 1.61; Persia, 1.32; Galicia, 0.947; Japan, 0.615; Peru, 0.511; Trinidad, 0.303; Germany, 0.189; Argentina, 0.170; Egypt, 0.094; Canada, 0.037; Italy, 0.002; and other countries, 0.006.

An interesting war-time development in connection with gas has been the installation of toluol-recovery plants in large municipal gas plants for the recovery of toluol from the oil in the course of gas manufacture, thus adding to the supply of toluol contributed by the by-product coke oven. It is a striking coincidence that both coal and petroleum furnish the basis for the manufacture of one of the most effective explosives known.

The flow of gas from the natural gas wells at Nuengamme, near Hamburg, has ceased altogether, after the pressure has been getting lower each month. This marks the end of one of the richest sources of income of the city of Hamburg, which controlled this gas well, the revenues each year amounting to about $500,000. The supply of natural gas in Germany as a whole is of course negligible, there being very few natural gas wells, the one near Hamburg being about the only one that could be said to be practically useful. This source of natural gas was particularly important during the war, owing to the shortage of coal.

The quantities of pulverised coal used in the United States annually in various manufactures are as follows:—In the cement industry, 6,000,000 tons; in the steel and iron industry, 2,000,000 tons; in the production of copper, 1,500,000 tons, and in the generation of power, 100,000 to 200,000 tons. To attain success the coal must be dried, crushed and pulverised until 95 per cent. will pass through a 100-mesh sieve, having 10,000 openings to the square inch. A cubic inch will contain over 200,000,000 particles, none of which will be greater than one-hundredth of an inch cube, and a large percentage less than one six-hundredth of an inch cube.

News of the rapidly increasing use of pneumatic riveting tools comes from both Clyde and Tyne areas. It has been one of the most marked features of the work of the Clyde shipyards during the last two or three months, and by the end of the year the extended use of these important tools will be reflected in the greater output of vessels on both the upper and lower reaches of the river. Most of the yards have now installed the necessary compressing apparatus. Thanks to the new arrangement for levelling up the wages of the men while they are learning to operate the machine, there has been no scarcity of willing workers. One important firm recently completed arrangements for doubling its present holding of pneumatic tools, and expects no difficulty in securing the necessary number of riveters.—*The Engineer.*

Powdered coal constitutes 85 per cent of the fuel used in calcining 93,500,000 barrels of cement made in America during 1917. This industry alone consumed 5,000,000 tons of powdered coal last year.

The tallest flag-pole in the world was raised at Camp Lewis on October twelfth, the pole measuring three hundred and forty-six feet from end to end. It was set in a concrete base sunk twelve feet in the earth. Engineers at Camp Lewis took a great interest in the event, as getting this pole into place and hoisting it is considered quite an engineering feat.

A new way of drying fruit juice, blood and eggs, called the Krayseska method, was demonstrated before the food authorities of Berlin and was found to be worth exploiting to a large extent; it was announced that plants of this type for treating about 140,000 eggs a day would shortly be erected in Berlin and Bucharest. The drying is done in a large iron cylinder five meters in diameter, in which a pair of big metal wings rotate rapidly, driven by a steam turbine. The fluid is lashed to foam, and dried by a current of hot air that is continually passing through the cylinder. The dried products go through no chemical change, and are directly soluble in water. They are in the form of a powder, which will keep for a long time and can of course be transported with great economy.

It is stated that the Medical Research Board of the Division of Military Aeronautics, in the U. S. A., has found a substitute for glass for pilots' goggles. The substance is hard, non-inflammable, and practically non-shatterable, and should be serviceable for windscreens and for "lights" on enclosed cars.

A new driving belt leather substitute is now being manufactured in Austria. This article, which is called driving-belt leather substitute or iron leather (according to an announcement of the Treasury to the Customs), is made of double iron wire spirals twisted together and in part slightly copper-plated by a chemical process. One sample is about 10 cm. broad. Another sample is of wire gauze strips interlaced with one-ply and two-ply paper yarn, partly with single and partly with double threads. It is bound at the edge with paper-yarn, then strongly impregnated with tar asphalt and flattened out between rollers. A third sample is bound with iron wire spirally twisted.

Some particulars of the paper substitute driving-belts, which are now being introduced into German workshops, are given in the *Bulletin des Usines de Guerre.* The paper is cut into narrow bands which are then spun. The belts are made by weaving or braiding. Woven paper belts are of two kinds—paper fabric and paper thread belts, the former being the more frequently used. The fabric is first cut into bands 40 m. long, which are subsequently made up according to the desired width and thickness. A core of strengthening material is interposed, either cotton or sheet metal, though more recently these cores have consisted of paper thread and metal wires interwoven. The core is surrounded with the paper strips and the whole sewn with strong thread. Belts so prepared are said to be very flexible and to wear satisfactorily. Woven paper belts have a tensile strength of from 100 to 125 kilos. per centimetre of width.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

OCTOBER 8.

1,280,642. TUNNEL-DRIER. George Hillard Benjamin, New York, N. Y.
1,280.672. AIR-HEATING APPARATUS. William F. Cox, Danville, Va.
1,280,767. DEVICE FOR WITHDRAWING LIQUID FROM CONTAINERS. George W. Lake, Rumford, R. I.
1,280,770. FLUID-OPERATED GEAR-SHIFTING MECHANISM. Laurits A. Laursen, Cornell, Wis.
1,280,780. PNEUMATIC CONVEYOR. Guido E. Lob, Chicago, Ill.
1,280,784. FOUNTAIN. Matt Luckiesh, Cleveland, Ohio.
1,280,811-2. PULSATION-PREVENTING APPARATUS FOR CENTRIFUGAL COMPRESSORS. Sanford A. Moss, Lynn, Mass.
1,280,843. PULSATION-PREVENTING MECHANISM FOR CENTRIFUGAL COMPRESSORS. Richard H. Rice, Lynn, Mass.
1,280,863. PNEUMATIC COTTON-GIN. Cecil L. Saunders, Cleveland, Ohio.
1,281,005. SOOT-BLOWER. Samuel J. Herman, Detroit, Mich.
1,281,041. AUTOMATIC AIR-CUSHION. Geo William MacKinnon, Boston, Mass.

1,281,068. AIR-PUMP. Daniel H. Prutton, Cleveland, Ohio.
1,281,072. PNEUMATIC PUMP. Homer S. Rogers, Milwaukee, Wis.
1,281,083. MOLD-LOADING DEVICE. Robert E. McCauley, Pittsburgh, Pa.
1,281,216-7. METHOD OF AND MEANS FOR PREVENTING PULSATIONS IN CENTRIFUGAL COMPRESSORS. Christopher A. Schellens, Marblehead, Mass.

OCTOBER 15.

1,281,297. AIR-BRAKE ATTACHMENT. Frank W. Cox, Bullsgap, Tenn.
1,281,345. BLOW-TORCH OR FIRE-POT. Maurice Goldberger, Fort Wayne, Ind.
1,281,431-2. ELECTROPNEUMATIC BRAKE. Walter V. Turner, Wilkinsburg, Pa.
1,281,433-4-5-6-7. FLUID - PRESSSURE BLAKE. Walter V. Turner, Wilkinsburg, Pa.
1,284,490. COMPRESSED-AIR ENGINE. Milo R. Billado, Jericho, Vt.
1,281,495. AUTOMATIC CAR AIR AND ELECTRIC COUPLING MECHANISM. William P. Bovard, Mansfield, Ohio.
1,281,597. EXTRACTION AND RECOVERY OF VAPOROUS AND GASEOUS CONSTITUENTS FROM COAL-GAS. Rudolf Lessing, High Holborn, London, England.
1,281,618. AIR-MOTOR. Charles McGregor, Derry, N. H.; Jennie H. McGregor administratrix.
1,281,667. DRYING-MACHINE FOR FIBROUS MATERIALS. Frederick G. Sargent, Westford, Mass.
1,281,674. AIR-BRUSH. Paul Seweryn, New York, N. Y.
1,281,801. FLUID-PRESSURE BRAKE. Geo. MacLoskie, Erie, Pa.
1,281,816. AIR - DIFFUSING APPARATUS. Carl H. Nordell, Milwaukee, Wis.
1,281,881. VACUUM-SEPARATOR. Harry A. Thuneman, St. Louis, Mo.
1,281,966. VACUUM - CONTAINER. Payson Irwin, Stamford, Conn.
1,281,972. ROTARY COMPRESSOR AND EXHAUSTER. John Johnston, London, England.
1,281,974. AIR-CHECK VALVE. Fred A. Kaeding, Somers, Mont.
1,281,995. CENTRIFUGAL COMPRESSOR. Sanford A. Moss, Lynn, Mass.

OCTOBER 22.

1,282,065. CENTRIFUGAL FAN FOR BLOWERS. John Froelich, St. Paul, Minn.
1,282,093. DESICCATION PROCESS. Frederick William Lietzow and Oscar Frederick Fleischer, Chicago, Ill.
1,282,120. FLUID-PRESSURE-TESTING MACHINE. Clarence L. Patterson, Detroit, Mich.
1,282,130. ELECTROPNEUMATIC BRAKE MECHANISM. James Richard Sloan, Howard F. Perry, and Ira V. Goodman, Altoona, Pa.
1,282,152. FLUID-OPERATED LATHE. Henry E. Warren, Ashland, Mass.
1,282,232. OIL-BURNER. Granville A. Humason, Houston, Tex.
1,282,243. ELECTRIC AIR-HEATER. Frank Kuhn and Jay A. Hand, Detroit, Mich.
1,282,345. AIR-FILTER. Frederick William Rogers Williams, London, England.
1,282,372. DRY-VAPOR GENERATOR. Alfred H. B-Roberts, Los Angeles, Cal.
1,282,416. BLOWPIPE AND CUTTING-TORCH. John Harris, Cleveland, Ohio.
1,282,444. PNEUMATIC ACTION FOR PLAYER-PIANOS. Frank G. Lynde, Newark, N. J.
1,282,477. VACUUM LIFTING-MACHINE. Carlton L. Smith, Saginaw, Mich., and Oscar I. Lewellyn, Kokomo, Ind.
1,282,506. AIR-PUMP ATTACHMENT FOR AUTOMOBILES. Chester R. West, Madison, Ga.
1,282,514. VACUUM - BOTTLE. Albert E. Wooden, Waterbury, Conn.
1,282,548. ELECTRIC VACUUM-CLEANER. Frank C. De Reamer, Schenectady, N. Y.
1,282,595. FLUID - COMPRESSING APPARATUS. Gottdank L. Kothny and Robert Suczek, Philadelphia, Pa.
1,282,623. METHOD OF AND APPARATUS FOR CASTING CHARGES FOR PROJECTILES. Percy G. Paris, Bethlehem, Pa.
1,282,639. CENTRIFUGAL PUMP, BLOWER, AND EXHAUSTER. George Richard Schueler, Kingston-upon-Hull, England.
1,282,675. RELEASE-VALVE. Oliver Joseph Cantrelle and George Alexander, New Orleans, La.
1,282,686. METHOD OF DESICCATING AIR FOR BLAST-FURNACE USE. Leon Goldmerstein, (now, by judicial change of name, Leon Cammen,) New York, N. Y.

OCTOBER 29.

1,282,771. APPARATUS FOR DRYING MATERIALS IN SACKS OR SIMILAR VESSELS. Hans Peter Dinesen, Herlov, Denmark.
1,282,802. GAS-BURNER. Heinrich J. Freyn, Chicago, Ill.
1,282,822. TUNNEL-DRIER. Gordon Don Harris, Bayonne, N. J.
1,282,841. FLUID-MOTOR. Charles A. Iles, Marion, Ohio.
1,282,881. PNEUMATIC DILATOR. John T. Landis, Nashville, Tenn.
1,282,907. LIQUID-FUEL BURNER. Daniel E. Miess and Alvyn R. Miess, Glendale, Cal.
1,282,928. DRILL. Ralph S. Peirce, Hinsdale, Ill.
1,282,963. METAL - CASTING APPARATUS. Fred Shroder, Chicago, Ill.
1,282,977. EJECTOR APPARATUS. Robert Suczek, Philadelphia, Pa.

1. The method of raising the pressure of elastic fluid, which consists in expanding an elastic motive fluid, entraining therein the elastic fluid whose pressure is to be increased, compressing the mixture of motive and entrained fluids by conversion of velocity into pressure, cooling said mixture while compressed, in a second stage expanding motive fluid, entraining therein said cooled compressed mixture, and compressing the resultant mixture by conversion of velocity into pressure.

1,282,978. CONDENSATE AND AIR REMOVING APPARATUS. Robert Suczek, Philadelphia, Pa.
1,282,980. PNEUMATIC MATTRESS. Nicholas M. Takach, Bridgeville, N. Y.
1,282,997. BLOWPIPE. Emile Waldmeier, Gulfport, Miss.
1,283,027. BLOWER FOR HORNS. George A. Arnold, Boston, Mass.
1,283,048. SOOT-BLOWER FOR WATER-TUBE BOILERS. John E. Bell, New York, N. Y.
1,283,097. AIR-BRAKE FOR AUTOMOBILES. Wiley Eugene Daniel, De Leon, Tex.
1,283,129. WINDMILL OR WIND-MOTOR. John T. Fisher, East Cleveland, Ohio.
1,283,144. PNEUMATIC SHOE-PRESS. John R. Gammeter, Akron, Ohio.
1,283,269. VACUUM-ERASER. Andrew D. Nichols, Harlowton, Mont.
1,283,298. SUCTION - CLEANER. Frank J. Quist, Worcester, Mass.
1,283,341. PNEUMATIC UPPER-LEATHER-CUTTING MACHINE. Michael J. Sloan, Binghamton, and Joseph L. Sloan, Endicott, N. Y.
1,283,416. AIR-COMPRESSOR. Paul Kuehn, Detroit, Mich.

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EVERYTHING PNEUMATIC

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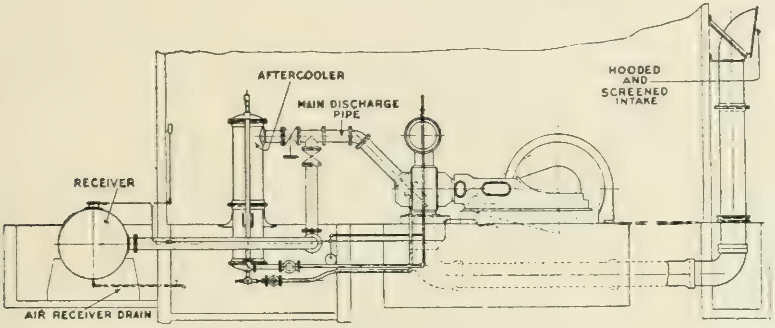


FIG. I. PROPER ARRANGEMENT OF AIR INTAKE AND PIPING

COMPRESSING AIR EFFICIENTLY

By Charles A. Hirschberg

Economical and efficient operation of air compressors demands regular inspection. The compressor as a whole should be inspected at least once a month, making necessary adjustments, such as taking up of packing glands and replacement of worn parts.

Examine air valves, which should present an oily surface free from carbon. Also examine ports and passages for carbon or other obstructions. Carbon desposit on valves prevents their seating properly, causes leakage and results in reduced compressor capacity and low efficiency. Obstructions in air passages reduce their area and cause loss in friction. Carbon deposit in combination with high temperature due to improper cylinder cooling, sticking of valves or insufficient lubrication may result in explosions, if allowed to persist. Remove any carbon deposit.

PACKING

Use of packings is often misunderstood. Drawing up too tightly will cause heating, and scoring of the piston rod. This means higher temperatures and increased mechanical friction, with transmitting of increased temperature to the air in the cylinder, which will cause trouble with moisture, lower the air density and thereby reduce the output.

In placing the packing in the stuffing box, put the rings in so that the joints of the several rings stagger. Fill the box without crowding and with new packng force in slightly with the gland until the compressor warms up; then draw up just enough to prevent blowing. Crowding the packing will squeeze out the lubricant it contains, causing the packing to become hard and unyielding.

If upon examination packing is found hard, it may be revived by removing, loosening up, and working in a mixture of graphite and grease.

An asbestos sheet packing is generally used between cylinder heads and cylinders. If for any reason it becomes necessary to remove a head, care should be exercised not to injure this head gasket. If necessary to replace it, be sure to use material of the same thickness as the original, so as to maintain the clearance established by the builder.

INLET AIR

Do not have the air intake open to the engine room. Carry it outdoors and extend upward a sufficient height, with hood and screen, to prevent foreign substances from **being** drawn in and to insure cool intake air.

Figure 1 shows an ideal method of handling the air intake.

Take the air into the compressor as cool **as** possible is the rule without any exception. Cooling the intake air is a direct saving **of** power **by** reducing the volume to be com-

Delivery in Cu. Ft. of Compressed Air per Min.	Equiv. Delivery in Cu. Ft. of Free Air per Min.	Size of Pipe, Inches																	
		1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	12	14	16
		Loss of Pressure, in Pounds, by Friction in 1000 Feet Lengths of Pipe																	
At 60 Pounds Gauge																			
9.84	50	18.24	5.06	1.95	.42	.13	.05	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14.73	75	.....	11.34	4.33	.95	.29	.11	.05	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19.64	100	.....	20.16	7.79	1.69	.52	.19	.08	.04	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24.60	125	.....	.....	12.23	2.65	.81	.30	.13	.07	.03	.....	.....	.....	.....	.....	.....	.....	.....	.....
29.45	150	.....	.....	17.53	3.80	1.16	.44	.19	.09	.05	.03	.....	.....	.....	.....	.....	.....	.....	.....
34.44	175	.....	.....	.....	5.17	1.58	.59	.26	.13	.07	.04	.01	.....	.....	.....	.....	.....	.....	.....
39.35	200	.....	.....	.....	6.77	2.09	.78	.36	.17	.09	.06	.02	.01	.....	.....	.....	.....	.....	.....
49.20	250	.....	.....	.....	10.61	3.24	1.22	.55	.27	.15	.08	.03	.01	.....	.....	.....	.....	.....	.....
58.90	300	.....	.....	.....	15.20	4.65	1.78	.78	.38	.21	.12	.05	.02	.01	.....	.....	.....	.....	.....
68.6	350	.....	.....	.....	.....	6.31	2.37	1.07	.53	.29	.17	.06	.03	.01	.....	.....	.....	.....	.....
78 6	400	.....	.....	.....	.....	8.28	3.11	1 40	.69	.39	.22	.08	.04	.01	.....	.....	.....	.....	.....
88.4	450	.....	.....	.....	.....	10.47	3.94	1.77	.88	.48	.28	.11	.05	.02	.01	.....	.....	.....	.....
98.4	500	.....	.....	.....	.....	.....	4.88	2.20	1.08	.60	.34	.14	.06	.03	.01	.....	.....	.....	.....
118.1	600	.....	.....	.....	.....	.....	7.03	3.17	1.56	.87	.49	19	.09	.04	.02	.01	.....	.....	.....
137.5	700	.....	.....	.....	.....	.....	9.52	4.29	2.12	1.17	.67	.27	.12	.06	.03	.02	.....	.....	.....
156.6	800	.....	.....	.....	.....	.....	.....	5.57	2.75	1.52	.87	.34	.15	.08	.04	.03	.01	.....	.....
176.5	900	.....	.....	.....	.....	.....	.....	7.08	3.49	1.94	1.17	.43	.19	.09	.05	.03	.01	.....	.....
196.4	1000	.....	.....	.....	.....	.....	.....	8.77	4 33	2.40	1.37	.54	.24	.12	.06	.04	.02	.01	.....
294.5	1500	.....	.....	.....	.....	.....	.....	.....	9.73	5.39	3.08	1.20	.55	.27	.15	.09	.03	.01	.....
393.7	2000	.....	.....	.....	.....	.....	.....	.....	.....	9.65	5.51	2.16	.98	.41	.27	.16	.06	.03	.01
492	2500	.....	.....	.....	.....	.....	.....	.....	.....	.....	8.61	3.36	1.53	.77	.42	.25	.09	.04	.02
589	3000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.82	2.19	1.11	.61	.36	.14	.06	.03
686	3500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6.54	2.97	1.50	.83	.48	.19	.09	.04
786	4000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.91	1.98	1.08	.63	.25	.11	.05
884	4500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.94	2.51	1.36	.79	.32	.15	.07
984	5000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6.19	3.10	1.69	.99	.39	.18	.09
At 80 Pounds Gauge																			
7.74	50	14.31	3.96	1.53	.33	.10	.03	.01	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11.3	75	.....	8.46	3.26	.71	.21	.08	.03	.01	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15.2	100	.....	15.31	5.92	1.28	.39	.14	.06	.03	.02	.01	.....	.....	.....	.....	.....	.....	.....	.....
19.4	125	.....	.....	9.64	2.09	.64	.24	.11	.05	.03	.01	.....	.....	.....	.....	.....	.....	.....	.....
23.2	150	.....	.....	13.79	2.99	.91	.34	.15	.07	.04	.02	.01	.....	.....	.....	.....	.....	.....	.....
27.2	175	.....	.....	.....	4.09	1.25	.47	.21	.10	.06	.03	.01	.....	.....	.....	.....	.....	.....	.....
31.0	200	.....	.....	.....	5.34	1.63	.61	.27	.13	.07	.04	.01	.....	.....	.....	.....	.....	.....	.....
38.7	250	.....	.....	.....	8.32	2.54	.96	.43	.21	.12	.07	.02	01	.....	.....	.....	.....	.....	.....
46.5	300	.....	.....	.....	12.01	3.67	1.38	.62	.30	.17	.09	.03	.01	.....	.....	.....	.....	.....	.....
54.2	350	.....	.....	.....	.....	4.99	1.88	.84	.41	.23	.13	.05	.02	.01	.....	.....	.....	.....	.....
62.0	400	.....	.....	.....	.....	6.53	2.45	1.11	.54	.30	.17	.06	.03	.01	.....	.....	.....	.....	.....
69.7	450	.....	.....	.....	.....	8.25	3.13	1.40	.69	.38	.22	.08	.04	.01	.....	.....	.....	.....	.....
77.4	500	.....	.....	.....	.....	10.81	3.83	1.73	.85	.47	.27	.10	.05	.02	.01	.....	.....	.....	.....
92.9	.600	.....	.....	.....	.....	.....	5.61	2.46	1.22	.68	.39	.15	.06	.03	.02	.01	.....	.....	.....
108.2	700	.....	.....	.....	.....	.....	7.46	3.37	1.66	.92	.53	.20	.09	.04	.02	.01	.....	.....	.....
124.0	800	.....	.....	.....	.....	.....	9.86	4.42	2.18	1.19	.69	.27	.12	.06	.03	.02	.01	.....	.....
139.5	900	.....	.....	.....	.....	.....	.....	5.61	2.77	1.54	.88	.34	.15	.08	.04	.02	.01	.....	.....
152	1000	.....	.....	.....	.....	.....	.....	6.64	3.29	1.82	1.04	.40	.18	.09	.05	.03	.01	.....	.....
232	1500	.....	.....	.....	.....	.....	.....	15.41	7.62	4.24	2.43	.95	.43	.22	.12	.06	.02	.01	.....
310	2000	.....	.....	.....	.....	.....	.....	.....	13.62	7.58	4.32	1.69	.77	.39	.21	.12	.04	.02	.01
387	2500	.....	.....	.....	.....	.....	.....	.....	.....	11.79	6.88	2.64	1.19	.60	.33	.19	.07	.03	.01
465	3000	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.72	3.79	1.73	.87	.48	.28	.11	.05	.02
542	3500	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.25	5.27	2.35	1.19	.65	.37	.15	.06	.03
620	4000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6.78	3.07	1.55	.85	.49	.19	.09	.04
697	4500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8.54	3.89	1.97	1.08	.66	.25	.11	.05
774	5000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10.55	4.79	2.46	1.33	.77	.30	.14	.07

FIG. 2. LOSS OF AIR PRESSURE IN PIPE TRANSMISSION

pressed. Also the capacity of the air to hold moisture rapidly falls off as its temperature is reduced.

TRANSMISSION PIPING

Pipe lines should be of ample size, as small transmission lines mean excessive loss of pressure due to friction. Large pipe lines are especially desirable where the pipes are long or the supply has to meet the demands of a great many devices. Reduced pressure due to friction means inefficient operation of tools.

The accompanying chart, Fig. 2, covering "Loss in pressure due to friction in pipe lines" will serve to indicate the need for having the pipe line amply large. Take, for example, the following case:

Delivery in Cu. Ft. of Compressed Air per Min.	Equiv. Delivery in Cu. Ft. of Free Air per Min.	Size of Pipe, Inches																	
		1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	12	14	16
		Loss of Pressure, in Pounds, by Friction in 1000 Feet Lengths of Pipe																	
At 100 Pounds Gauge																			
6.41	50	11.89	3.29	1.28	.27	.08	.03	.01	....	....	....	....	....	....	....	....	....	....	....
9.61	75	....	7.42	2.87	.62	.19	.07	.03	.01	....	....	....	....	....	....	....	....	....	....
12.81	100	....	13.20	5.11	1.15	.34	.12	.05	.02	.01	....	....	....	....	....	....	....	....	....
15.81	125	....	....	7.75	1.68	.52	.19	.08	.04	.02	.01	....	....	....	....	....	....	....	....
19.22	150	....	....	11.42	2.48	.76	.29	.13	.06	.03	.02	.01	....	....	....	....	....	....	....
22.39	175	....	....	....	3.36	1.03	.39	.17	.09	.04	.03	.01	....	....	....	....	....	....	....
25.62	200	....	....	....	4.43	1.36	.51	.23	.12	.06	.04	.02	.01	....	....	....	....	....	....
31.62	250	....	....	....	6.72	2.06	.77	.35	.17	.09	.05	.02	.01	....	....	....	....	....	....
38.44	300	....	....	....	9.95	3.04	1.14	.51	.25	.14	.08	.03	.01	....	....	....	....	....	....
44.78	350	....	....	....	13.41	4.11	1.54	.69	.34	.19	.11	.04	.02	.01	....	....	....	....	....
51.24	400	....	....	....	....	5.40	2.06	.92	.45	.25	.15	.05	.03	.01	....	....	....	....	....
57.65	450	....	....	....	....	6.85	2.57	1.16	.57	.32	.18	.07	.03	.02	.01	....	....	....	....
63.24	500	....	....	....	....	8.21	3.08	1.39	.68	.38	.22	.08	.04	.02	.01	....	....	....	....
76.88	600	....	....	....	....	12.21	4.58	2.14	1.03	.57	.33	.12	.05	.03	.02	.01	....	....	....
89.56	700	....	....	....	....	....	6.19	2.79	1.38	.77	.44	.17	.07	.04	.02	.01	....	....	....
102.5	800	....	....	....	....	....	8.13	3.67	1.81	1.00	.57	.22	.10	.05	.03	.02	.01	....	....
115.3	900	....	....	....	....	....	10.23	4.64	2.29	1.27	.76	.28	.13	.06	.04	.02	.01	....	....
126.5	1000	....	....	....	....	....	12.39	5.00	2.76	1.23	.88	.34	.16	.08	.04	.03	.01	....	....
192.2	1500	....	....	....	....	....	....	12.81	6.68	3.51	2.03	.78	.36	.18	.09	.05	.02	.01	....
256.2	2000	....	....	....	....	....	....	....	11.35	6.61	3.62	1.41	.67	.33	.18	.10	.04	.02	.01
316.2	2500	....	....	....	....	....	....	....	....	9.50	5.51	2.14	.97	.49	.27	.16	.06	.03	.01
384.4	3000	....	....	....	....	....	....	....	....	14.04	8.11	3.16	1.44	.76	.39	.23	.19	.04	.02
447.8	3500	....	....	....	....	....	....	....	....	....	10.95	4.26	1.93	.98	.53	.31	.12	.05	.03
512.4	4000	....	....	....	....	....	....	....	....	....	14.48	5.59	2.55	1.30	.72	.41	.16	.07	.04
576.5	4500	....	....	....	....	....	....	....	....	....	....	7.04	3.22	1.84	.89	.52	.21	.09	.05
632.4	5000	....	....	....	....	....	....	....	....	....	....	8.51	3.88	1.93	1.07	.63	.25	.11	.08
At 125 Pounds Gauge																			
5.26	50	9.88	2.70	1.05	.23	.07	.03	.01	....	....	....	....	....	....	....	....	....	....	....
7.89	75	22.20	6.07	2.37	.51	.16	.06	.03	.01	....	....	....	....	....	....	....	....	....	....
10.51	100	39.50	10.82	4.22	.91	.28	.10	.05	.02	.01	....	....	....	....	....	....	....	....	....
13.15	125	....	16.88	6.58	1.42	.43	.16	.07	.04	.02	.01	....	....	....	....	....	....	....	....
15.79	150	....	24.33	9.47	2.04	.63	.23	.11	.05	.03	.02	.01	....	....	....	....	....	....	....
18.41	175	....	33.05	12.90	2.78	.85	.32	.14	.07	.04	.02	.01	....	....	....	....	....	....	....
21.05	200	....	....	16.84	3.63	1.11	.42	.19	.09	.05	.03	.01	....	....	....	....	....	....	....
26.30	250	....	....	26.30	5.68	1.73	.65	.29	.15	.08	.05	.02	.01	....	....	....	....	....	....
31.58	300	....	....	37.90	8.18	2.51	.94	.42	.21	.12	.07	.03	.01	....	....	....	....	....	....
36.81	350	....	....	....	11.08	3.39	1.27	.58	.28	.16	.09	.04	.02	.01	....	....	....	....	....
42.10	400	....	....	....	14.51	4.44	1.67	.75	.37	.21	.12	.05	.02	.01	....	....	....	....	....
47.30	450	....	....	....	18.38	5.61	2.11	.95	.47	.26	.15	.06	.03	.01	.01	....	....	....	....
52.60	500	....	....	....	22.68	6.95	2.61	1.18	.58	.32	.18	.07	.03	.02	.01	....	....	....	....
63.20	600	....	....	....	....	10.00	3.76	1.69	.84	.46	.27	.10	.05	.02	.01	.01	....	....	....
73.70	700	....	....	....	....	13.60	5.11	2.31	1.14	.63	.36	.14	.06	.03	.02	.01	....	....	....
84.20	800	....	....	....	....	17.80	6.68	3.01	1.49	.83	.47	.18	.08	.04	.02	.01	.01	....	....
94.70	900	....	....	....	....	....	8.45	3.81	1.88	1.04	.60	.23	.11	.05	.03	.02	.01	....	....
105.1	1000	....	....	....	....	....	10.42	4.71	2.32	1.29	.74	.29	.13	.07	.04	.02	.01	....	....
157.9	1500	....	....	....	....	....	23.48	10.59	5.23	2.90	1.65	.64	.29	.15	.08	.05	.02	.01	....
210.5	2000	....	....	....	....	....	....	18.81	9.30	5.15	2.94	1.15	.52	.26	.15	.08	.03	.02	.01
263.0	2500	....	....	....	....	....	....	29.40	14.52	8.05	4.60	1.80	.82	.41	.23	.13	.05	.02	.01
315.8	3000	....	....	....	....	....	....	....	20.90	11.59	6.63	2.59	1.18	.60	.33	.19	.07	.03	.02
368.1	3500	....	....	....	....	....	....	....	28.51	15.78	9.01	3.53	1.61	.81	.45	.26	.10	.04	.02
422.0	4000	....	....	....	....	....	....	....	....	20.61	11.80	4.61	2.19	1.06	.58	.34	.13	.06	.03
473.0	4500	....	....	....	....	....	....	....	....	26.10	14.90	5.83	2.65	1.34	.73	.43	.17	.08	.04
526.0	5000	....	....	....	....	....	....	....	....	32.20	18.45	7.20	3.27	1.65	.90	.53	.21	.10	.05

FIG. 2. CONTINUED

Receiver Gauge Pressure	Diameter of Orifice												
	1/64 inch	1/32 inch	1/16 inch	1/8 inch	1/4 inch	3/8 inch	1/2 inch	5/8 inch	3/4 inch	7/8 inch	1 inch	1 1/4 inch	1 1/2 inch
Pounds	Discharge in Cubic Feet of Free Air per Minute												
2	038	.153	647	2 435	9.74	21.95	39.	61	87.60	119.50	156.	242.	350.
5	.0597	.242	965	3.86	15.40	34.60	61 60	96 50	133.	189	247.	384.	550.
10	.0842	.342	.136	5.45	21.8	49.	87.	136	196	267.	350.	543.	780.
15	.103	.418	1 67	6.65	26.70	60.	107.	167	240	326.	427.	665.	960.
20	.119	.485	1 93	7 7	30 8	69	123.	193	277	378.	494.	770.	....
25	.133	.54	2.16	8.6	34.5	77	138.	216	310	422.	550	860.	....
30	156	.632	2.52	10.	40.	90.	161.	252	362.	493	645.	1000.	....
35	.173	.71	2 80	11 2	44 7	100	179.	280.	400	550.	715.	......	....
40	19	.77	3 07	12.27	49 09	110.45	196.35	306.80	441 79	601.32	785.40	....	....
45	208	.843	3 36	13.4	53.8	121.	215.	336	482	658.	860.	....	....
50	225	.914	3 64	14 50	58 2	130	232	364.	522	710.	930.	....	....
60	.26	1 05	4 2	16 8	67.	151	268	420	604.	622	......	......	....
70	295	1.19	4 76	19	76	171	304.	476.	685.	930	....	....	....
80	.33	1.33	5 32	21.2	85	191	340.	532.	765.	1004.	......	......	....
90	364	1.47	5 87	23 50	94	211	376	587.	843.	..	......	....	....
100	40	1 61	6 45	25 8	103	231	412.	645	925.	...	...	....	....
125	486	1 97	7 85	31.4	125	282.	502	785.	....	....	....	....	....

FIG. 3. DISCHARGE OF AIR FROM ROUND HOLE TO ATMOSPHERE

The loss in pressure in transmitting 50 cu. ft. of free air per minute at 100 lb. pressure through 1000 ft. of 1-in. ppie is 11.89 lb., and only 0.27 lb. in transmitting the same volume of air the same distance through a 2-in. pipe.

Air lines should receive monthly inspection for leaks, which cost money and waste valuable compressor capacity. Assuming that 1 cu. ft. of air per min. at 100 lb. pressure costs $5 a year, this cost being computed from an estimated cost for electricity at 1c per kw.-hr., interest and depreciation at 10 per cent. and a year as 300 8-hr. days, the following tabulation demonstrates the economy of regular pipe line inspections:

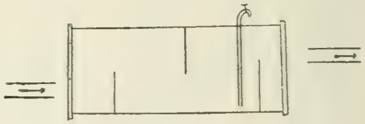
Diam. of hole, in.	Amount of Leak in cu. ft. free air per min.	Cost per year
1/16	6.45	$32
1/32	1.61	8
1/64	.40	2

Further calculations of possible loss through leaks may be quickly made by applying the above constant to the various discharge volumes shown in Fig. 3.

It is always advisable to provide numerous outlets in the transmission line. This will save future reconstruction and make it possible to use comparatively shorter lengths of hose. Where a number of supply lines radiate from the main line, it is well to provide a gate valve for cutting out any of these lines when they are to be idle for any considerable period of time.

Several methods are used of detecting air leaks: By the use of a lighted candle at all joints and connections; by swabbing soapy water around the joints, or by following the practice of one Illinois manufacturer, who, at regular intervals, puts essence of peppermint into the air system and then has all the pipes inspected. Leaks are revealed by the odor.

Pipe lines may be tested for loss of pressure



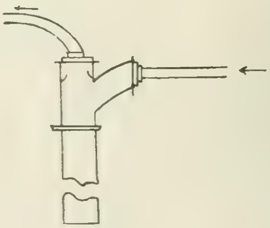


FIG. 4

FIG. 5

due to friction in transmission or to leakage by placing an air gage at the point of use of the air and comparing its reading with that of the gage on the air receiver. The remedies are increasing the size of the air line and eliminating of leaks.

REMOVING MOISTURE

All air contains moisture. When compressed the moisture becomes more evident, as in the compressed state there is more water in the air than it can contain. The excess moisture is deposited almost immediately as the air travels to the receiver; part of it travels with the air through the transmission lines, being gradually deposited and draining to low spots in the pipes, reducing the available area. Some of the moisture will find its way into the ports and exhaust passages of the machinery using the air, resulting in interference with proper operation by freezing at exhaust ports as the air expands to atmosphere.

One of the most effective and cheapest methods for the elimination of moisture from pipe lines is the placing of suitable traps at intervals in the transmission line into which the condensed moisture will precipitate and can be conveniently withdrawn.

A simple moisture trap, in Fig. 4, consists of an enlargement of the air line. It is provided with baffles and blowoff, the baffles having holes or slots drilled in the bottom so that moisture can work through to the blowoff pipe. By reason of the pressure always present in the separator the water can be taken from the top. This trap may be made of wrought or cast-iron pipe with flanged or screwed heads. A good proportion is separator diameter 3 times the air line diameter; 4 to 6 ft. long.

Another effective design is shown in Fig. 5, consisting of a long sweep tee three times the diameter of the pipe with a pocket below to catch the condensed moisture.

Both of these separators may be made locally from standard pipe fittings; also, there are a number of standard built moisture traps which may be purchased from various manufacturers.

Moisture traps should be placed at low points in the air line.

REHEATING COMPRESSED AIR

Reheating the air is a simple process and serves the double purpose of eliminating annoyance due to freezing as a result of the moisture which the air may contain, and at the same time increasing the air volume.

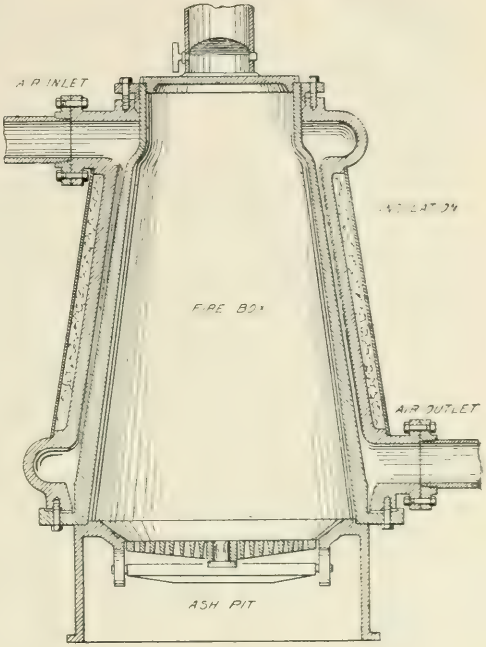


FIG. 6. STANDARD AIR REHEATER

When the warm compressed air leaves the compressor and passes through the receiver and the transmission lines to the point of use, the temperature of the air is considerably reduced. This represents a loss in volume. If the air were used immediately adjacent to the point of production, this loss would not be experienced, but the latter condition seldom, if ever, prevails.

Reheating the compressed air, at the point where it is to be utilized, a temperature of 250 deg. F., which is quite usual, results in expanding it in volume from 30 to 35 per cent., at a cost of about ⅙ of the heat units required to produce the same volume by compression. This approximation is based on the use of effective form of reheater, and the use of the air in the cylinder of the engine immediately after passing from the reheater.

In using the reheater, therefore, it should be placed as closely as possible to the point of use of the air, to prevent loss from radiation of heat after the reheating process.

The reheater may consist of a cast-iron chamber containing a coil of pipe exposed to a fire, or a current of hot gas or steam. Figure 6 shows a cross-section view of one stand-

Gauge Pressure Pounds	Absolute Pressure Pounds	Number of Atmospheres	Isothermal Compression		Adiabatic Compression			
			Mean Effective Pressure	H. P.	Mean Effective Pressure Theoretical	Mean Eff. Pressure plus 15% Friction	H. P. Theoretical	H. P. plus 15% Friction
5	19.7	1.34	4.13	0.018	4.46	5.12	0.019	0.022
10	24.7	1.68	7.57	0.033	8.21	9.44	0.036	0.041
15	29.7	2.02	11.02	0.048	11.46	13.17	0.050	0.057
20	34.7	2.36	12.62	0.055	14.30	16.44	0.062	0.071
25	39.7	2.70	14.68	0.064	16.94	19.47	0.074	0.085
30	44.7	3.04	16.30	0.071	19.32	22.21	0.084	0.096
35	49.7	3.38	17.90	0.078	21.50	24.72	0.094	0.108
40	54.7	3.72	19.28	0.084	23.53	27.05	0.103	0.118
45	59.7	4.06	20.65	0.090	25.40	29.21	0.111	0.127
50	64.7	4.40	21.80	0.095	27.23	31.31	0.119	0.136
55	69.7	4.74	22.95	0.100	28.90	33.23	0.126	0.145
60	74.7	5.08	23.90	0.104	30.53	35.10	0.133	0.153
65	79.7	5.42	24.80	0.108	32.10	36.91	0.140	0.161
70	84.7	5.76	25.70	0.112	33.57	38.59	0.146	0.168
75	89.7	6.10	26.62	0.116	35.00	40.25	0.153	0.175
80	94.7	6.44	27.52	0.120	36.36	41.80	0.159	0.182
85	99.7	6.78	28.21	0.123	37.63	43.27	0.164	0.189
90	104.7	7.12	28.93	0.126	38.89	44.71	0.169	0.195
95	109.7	7.46	29.60	0.129	40.11	46.12	0.175	0.201
100	114.7	7.80	30.30	0.132	41.28	47.46	0.180	0.207
110	124.7	8.48	31.42	0.137	43.56	50.09	0.190	0.218
120	134.7	9.16	32.60	0.142	45.69	52.53	0.199	0.229
130	144.7	9.84	33.75	0.147	47.72	54.87	0.208	0.239
140	154.7	10.52	34.67	0.151	49.64	57.08	0.216	0.249
150	164.7	11.20	35.59	0.155	51.47	59.18	0.224	0.258
160	174.7	11.88	36.30	0.158	53.70	61.80	0.234	0.269
170	184.7	12.56	37.20	0.162	55.60	64.00	0.242	0.278
180	194.7	13.24	38.10	0.166	57.20	65.80	0.249	0.286
190	204.7	13.92	38.80	0.169	58.80	67.70	0.256	0.294
200	214.7	14.60	39.50	0.172	60.40	69.50	0.263	0.303

FIG. 7. SINGLE STAGE COMPRESSION

ard type of air reheater, which requires no explanation.

POWER UTILIZED IN COMPRESSING

Two tables shown in Fig. 7 show the horsepower required for compressing air in single stage and two stage compressors at various gage pressures. All the conditions of the calculations given are explained in the headings.

MECHANICAL EFFICIENCY

Mechanical efficiency of an air compressor is represented by the ratio of the indicated air horsepower to the indicated steam horsepower in the case of a steam-driven machine, and to the brake horsepower in the case of a power-driven machine.

The difference between the two represents excess power required to overcome frictional resistance of the machine, which is largely dependent upon the design, the workmanship and the supervision received when in operation.

Mechanical efficiency of the well designed air compressor ranges between 90 and 95 per cent.

Let us assume a power-driven air compressor of the following size and displacement and determine its mechanical efficiency:

Diameter low-pressure cylinder, 16 in.; diameter high-pressure cylinder, 10 in.; stroke, 14 in.; r.p.m., 165; discharge pressure, gage, 100 lb.; piston displacement, cu. ft. per min., 534.

From brake test it was found that the brake horsepower is 93.

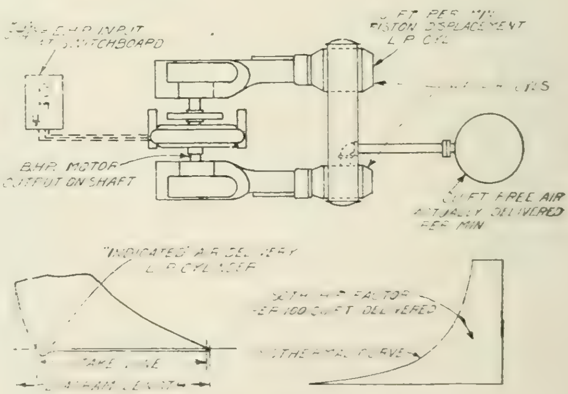


FIG. 8. ELECTRICALLY DRIVEN COMPRESSOR

Gauge Pressure Pounds	Absolute Pressure Pounds	No. of Atmospheres	Correct Ratio of Cylinder Volumes	Intercooler Gauge Pressure	Isothermal Compression		Adiabatic Compression				Percentage of Saving over One-stage Comp.
					Mean Eff. Pressure	H. P.	Mean Eff. Pressure Theoretical	Mean Eff Pressure plus 15% Friction	H. P. Theoretical	H. P. plus 15% Friction	
59	64.7	4.40	2.10	16.2	21.80	0.095	24.30	27.90	0.106	0.123	10.9
60	74.7	5.08	2.25	18.4	23.90	0.104	27.20	31.30	0.118	0.136	11.3
70	84.7	5.76	2.40	20.6	25.70	0.112	29.31	33.71	0.128	0.147	12.3
80	94.7	6.44	2.54	22.7	27.52	0.120	31.44	36.15	0.137	0.158	13.8
90	104.7	7.12	2.67	24.5	28.93	0.126	33.37	38.36	0.145	0.167	14.2
100	114.7	7.80	2.79	26.3	30.30	0.132	35.20	40.48	0.153	0.176	15.0
110	124.7	8.48	2.91	28.1	31.42	0.137	36.82	42.34	0.161	0.185	15.2
120	134.7	9.16	3.03	29.8	32.60	0.142	38.44	44.20	0.168	0.193	15.6
130	144.7	9.84	3.14	31.5	33.75	0.147	39.86	45.83	0.174	0.200	16.3
140	154.7	10.52	3.24	32.9	34.67	0.151	41.28	47.47	0.180	0.207	16.7
150	164.7	11.20	3.35	34.5	35.59	0.155	42.60	48.99	0.186	0.214	16.9
160	174.7	11.88	3.45	36.1	36.30	0.158	43.82	50.39	0.191	0.219	18.4
170	184.7	12.56	3.54	37.3	37.20	0.162	44.93	51.66	0.196	0.225	19.0
180	194.7	13.24	3.64	38.8	38.10	0.166	46.05	52.95	0.201	0.231	19.3
190	204.7	13.92	3.73	40.1	38.80	0.169	47.16	54.22	0.206	0.236	19.5
200	214.7	14.60	3.82	41.4	39.50	0.172	48.18	55.39	0.210	0.241	20.1
210	224.7	15.28	3.91	42.8	40.10	0.174	49.35	56.70	0.216	0.247	
220	234.7	15.96	3.99	44.0	40.70	0.177	50.30	57.70	0.220	0.252	
230	244.7	16.64	4.08	45.3	41.30	0.180	51.30	59.10	0.224	0.257	
240	254.7	17.32	4.17	46.6	41.90	0.183	52.25	60.10	0.228	0.262	
250	264.7	18.00	4.24	47.6	42.70	0.186	52.84	60.76	0.230	0.264	
260	274.7	18.68	4.32	48.8	43.00	0.188	53.85	62.05	0.235	0.270	
270	284.7	19.36	4.40	50.0	43.50	0.190	54.60	62.90	0.238	0.274	
280	294.7	20.04	4.48	51.1	44.00	0.192	55.50	63.85	0.242	0.278	
290	304.7	20.72	4.55	52.2	44.50	0.194	56.20	64.75	0.246	0.282	
300	314.7	21.40	4.63	53.4	45.30	0.197	56.70	65.20	0.247	0.283	
350	364.7	24.80	4.98	58.5	47.30	0.206	60.15	69.16	0.262	0.301	
400	414.7	28.20	5.31	63.3	49.20	0.214	63.19	72.65	0.276	0.317	
450	464.7	31.60	5.61	67.8	51.20	0.223	65.93	75.81	0.287	0.329	
500	514.7	35.01	5.91	72.1	52.70	0.229	68.46	78.72	0.298	0.342	

FIG. 7. TWO-STAGE COMPRESSION

The air indicator cards give an indicated horsepower of 83.6.

Therefore 83.6÷93=92 per cent. mechanical efficiency.

As stated above, loss in mechanical efficiency is determined by frictional resistance. This is a factor which can be largely controlled by the supervising engineer. In general it is desirable that attention be given to the lubrication system to insure that all rubbing parts are sufficiently lubricated at the following points: Bearings, crossheads, stuffing boxes and cylinders, as they constitute the chief sources of loss due to friction.

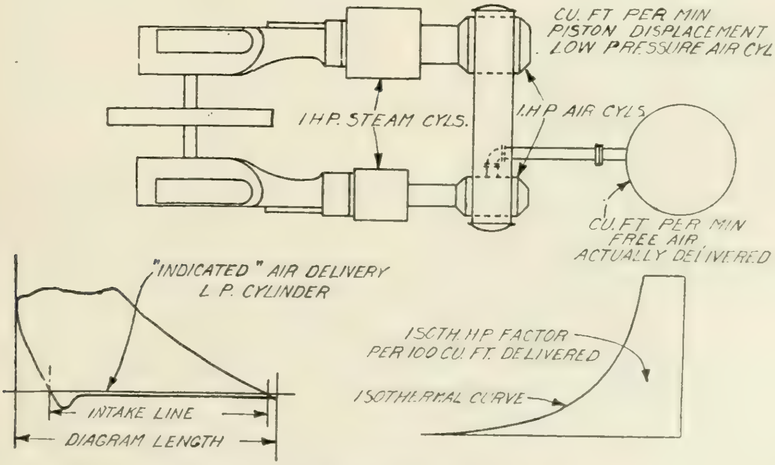

CU. FT. PER MIN PISTON DISPLACEMENT LOW PRESSURE AIR CYL
I.H.P. STEAM CYLS.
I.H.P. AIR CYLS
CU. FT. PER MIN FREE AIR ACTUALLY DELIVERED
"INDICATED" AIR DELIVERY L. P. CYLINDER
INTAKE LINE
DIAGRAM LENGTH
ISOTH. H.P. FACTOR PER 100 CU. FT. DELIVERED
ISOTHERMAL CURVE

FIG. 9. STEAM DRIVEN COMPRESSOR

Bearings should be drawn up only enough to insure smooth operation, without undue pressure. Instructions covering the packing of stuffing boxes have already been given. Crosshead guides must be free enough to permit the crosshead to operate without undue pressure, and yet work without knocking.

AIR COMPRESSOR EFFICIENCIES

Different measurements necessary for calculation of efficiencies are given on the diagrams shown in Figs. 8 and 9.

Here following are stated the ratios of these measurements resulting in the respective efficiencies and performance measurements of an electrically driven and a steam driven compressor.

All compression efficiencies should be subject to correction to perfect intercooling if specified amount of water at specified temperature is not available.

COMPOUND VS. SIMPLE AIR COMPRESSORS

The theory of compound or stage compression is very readily understood. It is generally conceded that compound or stage compression should be employed, (a) with small capacity machines when pressures range over 125 lb., (b) with larger capacity machines when pressures range above 70 lb. The heat of compression increases with the pressure, therefore, the higher the pressure, the more difficult it is to reduce the temperature of the air to a point where efficient compression con-

FOR ELECTRICALLY DRIVEN COMPRESSOR

$$\frac{\text{B. H. P.}}{\text{E. H. P.}} = \text{Motor Efficiency.}$$

$$\frac{\text{I. H. P. Air Cylinder}}{\text{B. H. P. on Shaft.}} = \text{Mechanical Efficiency.}$$

$$\frac{\text{Free air actually delivered}}{\text{Piston Displacement}} = \text{Actual Volumetric Efficiency.}$$

$$\frac{\text{Length L. P. Intake Line}}{\text{Length Indicates Diagram}} = \text{Indicated Volumetric Efficiency.}$$

$$\frac{\text{Actual Volumetric Efficiency}}{\text{Indicated Volumetric Efficiency}} = \text{Slippage Efficiency.}$$

$$\frac{\text{I. H. P. Air Cylinder x 100}}{\text{Cu. ft. actually delivered per min.}} = \text{I. H. P. per 100 cu. ft. delivered per min.}$$

$$\frac{\text{E. H. P. Input at Switchboard x 100}}{\text{Cu. ft. actually delivered per min.}} = \text{E. H. P. per 100 cu. ft. delivered per min.}$$

$$\frac{\text{Isothermal Factor}}{\text{I. H. P. per 100 cu. ft. delivered per min.}} = \text{Isothermal Compression Efficiency.}$$

$$\frac{\text{Isothermal Factor}}{\text{E. H. P. per cu. ft. delivered per min.}} = \text{Overall Isothermal Compression Efficiency.}$$

FOR STEAM DRIVEN COMPRESSOR

$$\frac{\text{I. H. P. Air Cylinders}}{\text{I. H. P. Steam Cylinders}} = \text{Mechanical Efficiency.}$$

$$\frac{\text{Free air actually delivered}}{\text{Piston Displacement}} = \text{Actual Volumetric Efficiency.}$$

$$\frac{\text{Length L. P. Intake Line}}{\text{Length Indicates Diagram}} = \text{Indicated Volumetric Efficiency.}$$

$$\frac{\text{Actual Volumetric Efficiency}}{\text{Indicated Volumetric Efficiency}} = \text{Air I. H. P. per 100 cu. ft. delivered per min.}$$

$$\frac{\text{Isothermal Factor}}{\text{Air I. H. P. per 100 cu. ft. delivered per min.}} = \text{Isothermal Compression Efficiency.}$$

$$\frac{\text{Isothermal Factor}}{\text{I. H. P. Steam Cylinder per 100 cu. ft. per min.}} = \text{Overall Isothermal Compression Efficiency.}$$

$$\frac{\text{lbs. Steam per hour}}{\text{I. H. P. Steam Cylinder}} = \text{Steam Consumption per I. H. P. hour.}$$

$$\frac{\text{lbs. Steam per min. x 1000}}{\text{Cu. ft. free air delivered per min.}} = \text{lbs. Steam per 1000 cu. ft. air delivered.}$$

ditions and proper air cylinder lubrication obtain. For instance, in compressing air to 100 lb. terminal gage pressure in a single cylinder, the final temperature would be about 485 deg. F. Some of this heat would be absorbed by the cylinder walls and water jackets, but the final temperature would remain too high to insure efficient compression conditions and proper lubrication.

In Fig. 10 is shown a theoretical combined indicator diagram from a two-stage compressor. It is assumed that the compression follows the adiabatic curve in both cylinders, with perfect intercooling between.

In Fig. 10, AB = volume of low pressure cylinder; CD = volume of high pressure cylinder; both are drawn to the same scale. ACF = pressure to some designated scale; BEK (adiabatic curve) = relation between pressure and volume for any piston position, with no intercooling and no radiation through the cylinder walls.

In this curve the product $PV^{1.41}$ is constant (1.41 is the ratio between the specific heat of air at constant pressure and constant volume), where P = pressure and V = volume. BDH (isothermal curve) = relation between pressure and volume provided the temperature of the air under compression could be kept constant so that the product PV would also be constant.

Air taken into the low-pressure cylinder at zero gage pressure, is compressed along the adiabatic curve BE until at E it attains a pressure of 26.3 lb., equal to that of the intercooler, which allows the discharge valves to open and the air to pass into the cooler. In the intercooler, the volume of a definite weight of the air is reduced from CE to CD, so that the volume entering the high-pressure cylinder is less to the extent of DE, which is the same scale as CD and AB. This means that the given weight of air represented by the volume CE at a gage pressure of 26.3 lb., when cooled to the same temperature at which it was originally taken into the low-pressure air cylinder will be reduced in volume to CD provided the pressure of 26.3 lb. remains constant.

Air taken into the high-pressure air cylinder at 26.3 lb. is compressed along the adiabatic curve DG. At G the high-pressure discharge

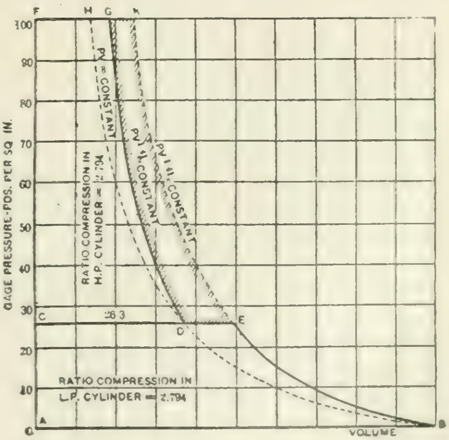


FIG. 10. COMBINED DIAGRAM

valves open and the air is discharged into the receiver at the desired gage pressure of 100 lb.

The shaded portion represents the power saving effected by the intercooler.

The saving due to the reduction in temperature between stages is not the only advantage of stage compression. The maximum temperature in each cylinder is reduced to a point where the heat can be more thoroughly drawn off by the water jackets surrounding the cylinder walls; also, the lower temperature in the cylinder is an insurance of good lubrication of piston, valves, etc.

As already indicated, the theoretical function of the intercooler in stage compression is to reduce the temperature of the air after it leaves the low-pressure cylinder to the same point at which it was first taken into that cylinder, before it enters the next stage cylinder.

Under practical working conditions, however, it will be found that the majority of coolers fail to accomplish this result and a reduction to within 5 to 10 deg. of the original temperature is considered a good accomplishment.

The intercooler consists of a shell containing a nest of tubes arranged in series or groups through which water flows successively, entering the bottom row and finding an outlet through the top row. Surrounding the water tubes is a series of baffle plates, which direct the flow of the air so as to split it up into thin films and insure intimate contact with the cold water tube surfaces. By reducing the spacing of these baffles as the high-pressure cylinder is approached the most efficient velocity of air in transit is attained.

When the air comes in contact with the cold tube surfaces, condensation of the moisture occurs, and it drips and flows down into the bottom of the shell. In order to drain this condensed water the intercooler is usually placed at an incline, so that the water will flow into the pocket surrounding the water separator where a drain cock is provided for the occasional removal of the water.

Temperature changes in the intercooler cause the tubes to expand and contract, and in order to provide for this it is customary for the best of tubes to be fixed at one end only, while the other end, including the water box, is left free to move with the tube plate.

AIR COMPRESSOR REGULATION

As for any other piece of machinery, the load factor of an air compressor is the average amount of work actually done, divided by the maximum capacity for work. The result represents the commercial efficiency of the machine, or in other words, the overall cost of production.

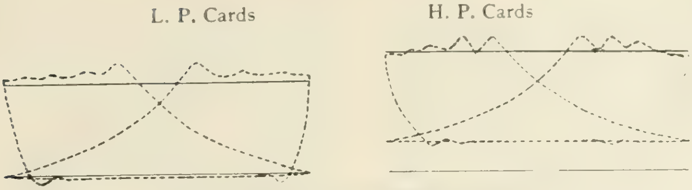
It is quite usual to install an air compressor to take care of the maximum demand and depend upon some automatic means of regulation or unloading to vary the output of the machine to fluctuating needs. This varies the horsepower input with the load and effects a saving in cost of operation.

It is further quite usual where the load will vary materially, especially in electrically-driven plants of large capacity, to install a number of small units and vary the number operating, keeping them at full load, to comply with changes of load, to assist in maintaining the highest overall economy. In such cases, regulation depends upon automatic starting and stopping.

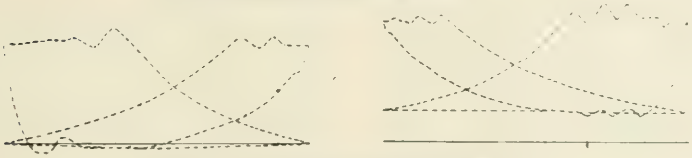
The reduction in horsepower input with power-driven air compressors controlled by some form of partial unloading device is not in direct ratio to the reduction in output. For instance, in Fig. 11 is shown a series of cards taken from 28 by 17½ by 21-in. electrically-driven two-stage air compressor, operating at 185 r.p.m. and equipped with a four-step clearance regulator. It will be noted that at three-quarter load capacity, the horsepower input is 77.5 per cent; at half load, the horsepower input is 55 per cent; at quarter load, it is 30 per cent, and at no load 3.6 per cent. The difference is accounted for by the fact that the mechanical efficiency drops off rapidly with a decrease in load; for example, in this particular case at full load the efficiency is 94 per cent, three-quarter load 92 per cent, half load 87.5 per cent, and at quarter load 80 per cent.

Air compressor control devices are usually set by the manufacturer to meet the conditions imposed by the particular installation, and as the design of these devices varies with the different manufacturers, instructions of only a very general nature can be given here.

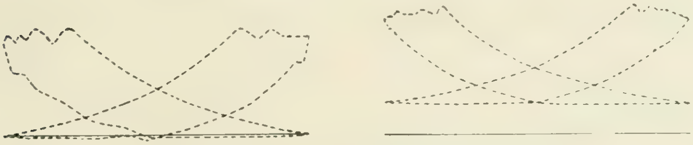
If the device fails to function properly, it is probably due to an obstruction in the way of dirt or other foreign substance, and not to a need for readjustment. It should be thorough-



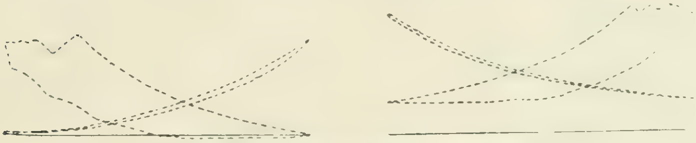
Full Load—Measured Capacity 2338 cu. ft. per Min.
I. H. P. 419 100% Capacity. 100% Power



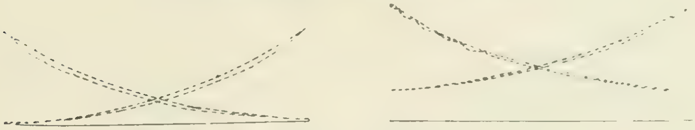
$\frac{3}{4}$ Load — Measured Capacity 1753 cu. ft. per Min.
I. H. P. 325 75% Capacity; 77.5% Power



$\frac{1}{2}$ Load — Measured Capacity 1169 cu. ft. per Min.
I. H. P. 230 50% Capacity; 55% Power



$\frac{1}{4}$ Load — Measured Capacity 584 cu. ft. per Min.
I. H. P. 125 25% Capacity; 30% Power



No Load — Measured Capacity 000 cu. ft. per Min.
I. H. P. 15 0% Capacity; 3.6% Power

FIG. 11

ly cleaned and care taken in reassembling to adhere to the adjustment existing prior to the cleaning.—*Power Plant Engineering.*

COOLING AND DRYING THE AIR IN DEEP MINES

By Sydney F. Walker

The difficulty which must be experienced in getting coal at depths of 5,000 to 6,000 feet will be principally due to the heat and humidity of the air. The present paper is intended to suggest that the difficulty may be overcome by treating each individual mine, each pair of shafts and the workings connecting them, in the same manner as modern cold stores are treated: cooling and drying the air entering the mine, and, if necessary, drying the air or portions of it in-bye. The great majority of modern cold stores are handled on the cold dry-air system. The air is exhausted from each cold chamber and passed through an apparatus that cools it and at the same time absorbs the moisture that the cooled air is no longer able to carry. The cold, dry air then returns to the cold chamber, where it receives a certain quantity of heat, and takes up any moisture that is given off by the produce held in the store, the higher temperature due to the heat taken from the store enabling it to absorb the moisture. It then again passes to the cooling and drying apparatus, and so on.

MOIST HOT AIR THE TERROR

It will be remembered that, according to Dr. Haldane's classical experiments, carried out a few years ago, it is not so much heat *per se* that affects workers in coal mines and in other places where high temperatures rule, as heat combined with moisture in the atmosphere. From figures before the present writer, it would appear that in some mines now working in the United Kingdom dry-bulb temperatures considerably over 80 deg. Fah. are reported, while wet-bulb temperatures in certain parts of the workings are found within a few degrees of the dry bulb. This means that the humidity of the atmosphere where these records are made is in the neighborhood of 80 per cent. According to Dr. Haldane's experiments, as the present writer understands them, comparatively high temperatures are bearable providing that the humidity is low; considerably over 80 deg. Fah. can be borne, if the humidity is in the neighborhood of 50 to 60 per cent. A little consideration will show that this is to be expected; it will be remembered that the perspiration which exudes from our sweat glands performs the very important office of cooling the body, and keeping down the blood pressure, this effect being due to its own evaporation. The action is very similar to that which is so common in India and elsewhere in the Tropics: of cooling wines, for instance, by wrapping them in wet towels and laying them in the sun. The wet in the towel evaporates in the heat of the sun's rays, and a considerable portion of the heat necessary to enable it to assume the vaporous condition is taken from the bottle and the contents. Similarly the heat necessary to enable the perspiration to evaporate is taken largely from our bodies; that is why we catch cold if we sit in a draft, or if our clothes get wet. In order that the perspiration may evaporate another condition is also necessary, viz., that the tension of the vapour already present in the air in the neighborhood is sufficiently low to allow of the forming of vapour from the perspiration. When the humidity of the air in which men are working is high, the vapour tension in the air is high and evaporation of the perspiration on their bodies is checked, and may be prevented entirely. The condition is very similar to that ruling in the Plains of India just before the rains; the atmosphere is so full of moisture that perspiration is almost impossible.

If the air entering the mines, therefore, is cooled and dried, it will behave in the workings of the mine exactly as the air does in a cold store; its temperature will be raised, and it will absorb any moisture that is present, up to the capacity of the temperature it reaches; the humidity of the air in which the men work will be lowered; perspiration will be carried on, with more or less freedom, and men will be able to work with a certain amount of comfort. The degree of comfort will depend upon the lowness of the temperature of the air, and of its humidity.

HOW TO ARRANGE IT

In order to arrange the matter on similar lines to those ruling in cold stores, it will be necessary to follow modern cold-storage methods, and to close over both pit tops; the air circulating continually round and round, through the cooling and drying apparatus, down the downcast pit, through the workings, and up the upcast. As with cold stores also, it could be arranged that fresh air should be allowed to enter the mine for a certain time occasionally, and the cooling and drying process again carried out; this will prevent the air getting stale, and could easily be done at week-ends. It would be necessary to provide airlocks at each pit top, so that the work could go on just as it does in cold stores, with very little ingress of outside air. By an airlock is meant, as readers are aware, a closed chamber leading to the outside air on one hand, and to the cold chamber on the other; in this case, the mine. An air-lock has two doors, which are only opened at intervals and one at a time. Mining men are familiar with airlocks; they have them in the connecting passages between the upcast and downcast pits. It would not matter whether the air was forced down the downcast pit or exhausted up the upcast pit; the cooling and drying apparatus would have to be in the neighborhood of the downcast pit, and all the air entering the pit would have to go through the drift or channel leading to the cooling and drying apparatus, and thence into the pit.

In those pits where a considerable amount of moisture comes away from the strata, cooling and drying, or drying apparatus alone, might be arranged for the air in that particular part of the mine, airlocks being provided and the air being directed through the cooling and drying apparatus so fixed. The air entering the mine may be cooled to any extent that may be desired; it is merely a matter of the size of the cooling plant and the power required to work it; also the air may be dried to any extent within the limits of the temperature to which the air is cooled.

It will be remembered that the capacity of air for absorbing the vapour of water varies with the temperature of the air, and increases very rapidly as the temperature rises; thus, at 60 deg. Fah., saturated air contains about 6 grains of moisture per cubic foot, at 70 deg. Fah. it contains about 8½ grains, at 80 deg. Fah. about 11 grains, at 90 deg. Fah. about 14½ grains, and so on. As the air coming out of the mine passed over the cooling apparatus, its lowered temperature would deprive it of the ability to hold a certain weight of water, which would be deposited upon any convenient cold surface or absorbent that was present.

MOISTURE ABSORBENTS

In modern cold-storage work it is usual to provide an absorbent, a solution of chloride of calcium being the most common. This salt has a strong affinity for moisture; it is known as a deliquescent salt, and in the solid state it will attract moisture in air passing over it, and gradually become liquid. In the liquid state it easily absorbs moisture, the density of the salt in the solution becoming less and less. With calcium chloride solutions, the lower the temperature of the solution, the larger is the quantity of vapour that a given quantity of solution will absorb, other conditions being the same. In cold-storage work a rather dense solution of calcium chloride, which remains liquid at very low temperatures—very much lower than water—is cooled to a figure depending upon the temperature to which the air being dealt with is to be cooled. The cold brine is usually made to run over some metal surface, the air to be cooled being forced over the same surface, the cooling and drying being accomplished at the same time. One system that has met with great success comprises a number of corrugated galvanized iron plates suspended vertically, parallel with each other, with a small space between adjacent plates. There is a trough below the plates, and the cold brine is pumped from the trough to a perforated pipe above the plates, and is allowed to trickle down over the surface of the plates, and to drop into the trough below. The air to be cooled is forced by a fan through the spaces between the corrugated plates; its contact with the cold brine and the cold plates lowers its temperature, and at the same time the film of cold brine upon the corrugated plates absorbs all the moisture the air has to part with. The liquid in the trough below the plates becomes gradually weaker and weaker in calcium chloride, until when the density reaches a certain figure it is subjected to heat, and a portion of the liquid driven off by evaporation. The absorption of the vapour from the air gradually raises the temperature of the liquid brine, and lowers its capacity for absorbing moisture; it also lowers and lessens its ability to cool the air in contact. A complete apparatus, therefore, will be a refrigerating plant as described below, and some arrangement of liquid brine, wetting some metal surface over which the air is made to pass. The cooling and drying apparatus may be fixed in any convenient part of the connecting passage between the upcast and downcast pits. The only essential condition is that the whole of the air entering the downcast pit passes through it; it is safer to fix the apparatus near the top of the downcast pit, so as to guard against leakage of air.

REFRIGERATING ARRANGEMENT

The apparatus usually employed would consist of a refrigeration compressor, a condenser, and an expansion tank. The refrigerant, which may be ammonia, carbonic acid, or sulphurous acid, circulates round and round through the three parts of the apparatus. There is a coil of pipe in the condenser, into which the gas is pumped by the compressor at a certain pressure, depending upon the refrigerant and on the temperature of the water available for use in the condenser. The gas is condensed to the liquid form, very much in the same way as steam is condensed, and the condenser employed is a special form of surface condenser. There is another coil of pipe in the expansion tank, and the liquid refrigerant is allowed to flow into the coil, at a certain rate, depending upon the temperature required in the substance to be cooled. After the liquid has expanded to the gaseous state in the expansion coil, it is sucked into the compressor, compressed and forced into the condenser. In modern practice, a receiver for the liquid refrigerant is sometimes placed between the condenser and the expansion coils. It will be understood that the apparatus named, with the pipes connecting them together, form a closed circuit, in which the refrigerant is continually circulating as long as the apparatus is at work.

A second circuit is formed by the brine in the expansion tank; the cooling apparatus (which may consist of a grid of pipes through which the brine flows, or more usually, as explained above, some apparatus in which metal surfaces are wetted by the cold brine); and a pump, together with pipes connecting them. The brine is kept circulating through the expansion tank and through the cooling apparatus by means of the pump; it absorbs heat from the air in the air-cooling apparatus, which it delivers to the expansion coils as it flows through the expansion tank; the heat delivered to the expansion coils being transmitted via the compressor and the condenser to the cooling water of the condenser.

A third circuit is the air circuit, formed in this case by the two shafts, the workings, the connecting passage between the shafts, the cooling apparatus, and the fan; and the air is kept circulating round and round, continually taking up heat from the mine, and delivering it by way of the cooling apparatus, the compressor, and the condenser, to the cooling water of the condenser.

There is another apparatus that may be employed, with ammonia only as the refrigerant, in place of the compressor. It is called the absorption apparatus, and consists of two vessels partially filled with a solution of ammonia. One of these vessels is subject to heat, usually by the aid of steam pipes, and is constantly driving off the ammonia that has been held in solution, compression taking place in the gas space just as it does with steam in the steam space of a steam boiler. The compressed gas is delivered to the condenser, just as with the compressor; thence to the expansion coils, and thence to the other vessel, known as the absorber. In the absorber the solution of ammonia is maintained at a low temperature and a low density, and there is a constant exchange between the absorber and the generator, as the other vessel is called. There are accessories with this plant, arranged to clean and dry the gas before it passes to the condenser. The writer mentions this apparatus, as the exhaust steam from the winding and other engines might be used for the purpose.

The refrigerating apparatus employed must be large enough, not only to lower the temperature of the air circulating through the mine, but also to abstract the latent heat from the water vapour carried in suspension in the air, in order that the vapour may be enabled to condense, and be absorbed by the cold brine.

REFRIGERATION COMPUTATION

The principal unit employed in connection with refrigerating plant is the ton of refrigeration; it is the number of B.Th.U. that a ton of ice, supposed to be at freezing point, will absorb in passing to the liquid state in 24 hours. In the United Kingdom this means 318,080 B.Th.U. per 24 hours, or 221 per minute. This figure must not be confused with the number of B.Th.U. required to make a ton of ice. The latent heat of water that has to be extracted in order that it may be converted into ice at 32 deg. Fah. is 142 B.Th.U. per lb., and the above figure for the ton of refrigeration is obtained by multiplying 142 by 2,240. In America, where the net ton is only 2,000 lbs., the ton of refrigeration is 284,000 B.Th.U. per 24 hours. Stable ice is always at a very much lower temperature than 32 deg. Fah., so the above figure is only hypothetical; but machines are made to furnish so many tons of refrigeration, just as engines are built to furnish so many horse power.

The writer has made a rough estimate of the size of plant required to deal with 100,000. cub. ft. of air. In the first place, he has taken conditions that he believes actually exist in some mines in the United Kingdom at the present day—a dry-bulb temperature of 85 deg. Fah., and a wet-bulb temperature of 80 deg. Fah. This means a humidity of 80 per cent., at the above air temperature.

To cool the above quantity of air through 10 deg. Fah., and to absorb the latent heat of the vapour of water that would be deposited due to the cooling of the air, would require a refrigerating plant of rather over 1,000 tons; to cool it through 20 deg. Fah. and to absorb the latent heat of the additional moisture that would be condensed would require a plant of 2,100 tons; and to cool the air through 30 deg. Fah. and absorb the moisture would require a plant of 3,200 tons.

Air at 110 deg. Fah. and 70 per cent. humidity would probably not be so humid as in the case quoted above, due to its higher temperature; it would require refrigerating plant of approximately 4,500 tons to cool it to 70 deg. Fah., and to absorb the latent heat of the vapour that would condense.

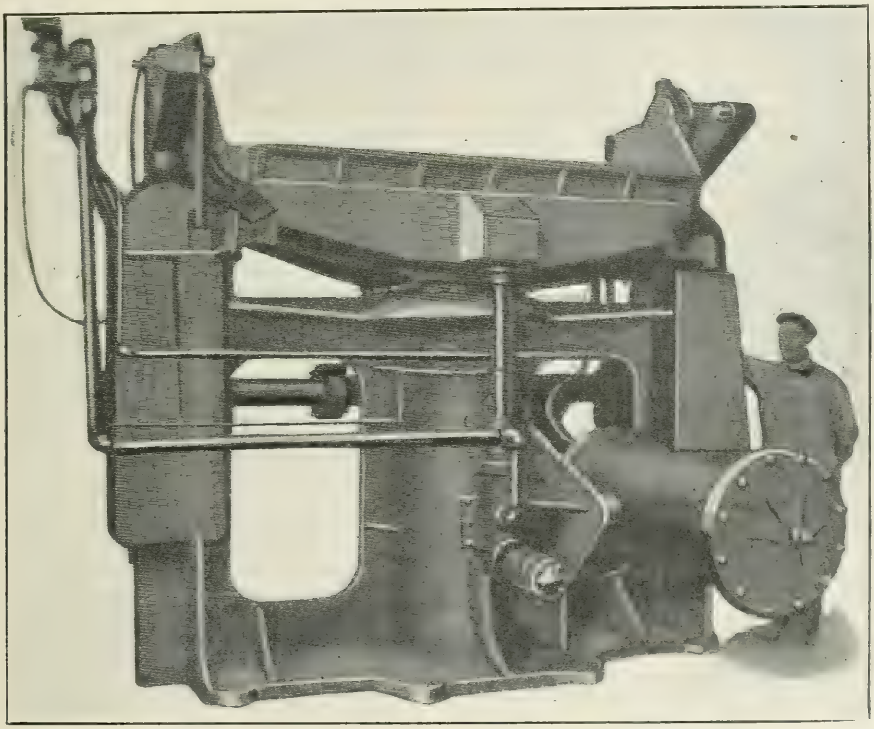
The power required to drive the refrigeration compressors might be taken for these large sizes at 1 h.p. per ton of refrigeration. Power would be required in addition for the brine pump and, of course, for the fan; also for pumping the cooling water for the condenser.

The writer is aware that the above figures are large, and that the apparatus would be costly, but if it enables us to get the coal at the lower depths, he makes out that the large cost would only be a small percentage of the value of the coal that its use would enable us to win.

A GIANT PNEUMATIC MOLDING MACHINE

The half-tone on this page gives us an idea of the appearance of the biggest pneumatic molding machine ever built. It weighs over 18 tons and is a very complete and up-to-date machine, built by the Cleveland Osborn Manufacturing Company, Cleveland, for the Bettendorff Company, Bettendorff, Iowa, for molding locomotive side frames. It is here shown on the erecting floor of the shop where it was built. When installed in the foundry for service it of course will not make such a show as it will be located in a pit and merely the table, roll-over device and track will be above the ground level.

The overall length of the roll-over table is 106 inches and the width of flask that may be accommodated, depending upon the depth, is from 48 to 60 inches. The pattern draw is 24 inches and the machine has a lifting capacity of 8500 pounds at 80 pounds air pressure. Two of these machines have been built for the Bettendorf Co. for use in its steel foundry. It will be noted that the entire frame is a single casting and it is practically a two-piece machine. The load is handled on approximately balanced centers. The machine is equipped with a forced feed oiling system and adjustable air-balanced piston valves. The castings are of steel and semi-steel construction.



The amount of time and labor saved by this machine is tremendous. It not only jar-rams the mold, but rolls it over, draws the pattern and deposits the mold on a run-out rack from which it is lifted to the floor by a crane for core setting, closing and pouring. This machine is indicative of the tendency in molding machine manufacture toward the installation of larger units and the economies that may be effected on large molds are much greater proportionately than on small work.

COMPRESSED GAS FOR MOTOR VEHICLES IN ENGLAND

The only instance in which compressed gas has been regularly used for some years is that of the Neath Corporation tramways, where the receivers are charged up to a pressure of 200 lb. per sq. in., the cost of compression working out to less than 5 per cent. of the total cost of the gas. At Neath, however, there are facilities for obtaining a fresh charge at reasonable and convenient intervals, so that conditions are scarcely to be compared with those in the metropolitan area. In fact, the London General Company find that conditions in general call for the employment of a very much greater degress of compression than has hitherto been found practicable, with the result that their new containers are to be charged to a maximum pressure of 1,000 lb. per sq. in.

The extremely high pressure involved has required the employment of storage cylinders of special construction. Two of these cylinders are used on each omnibus, being placed one on either side beneath the interior seats. The cylinders have each a compressed gas capacity of rather more than 600 cu. ft., so that a run of 20 miles may be made before recharging becomes necessary. The main body of the cylinders, composed of copper, is 10 in. in internal diameter and 9 ft. in length, while the two ends are formed of circular steel plates so fitted as to make a perfectly gas-tight joint on a radius formed on the ends of the copper tube. The whole is strengthened by six steel stays, which pass through the cylinder from end-plate to end-plate, and finally the exterior periphery of the cylinder is wound with three layers of steel tape 1-16 in. thickness. It is pointed out that this principle of construction will avoid bulging or sectional fracture, while any tendency towards distortion will be in the form of elongation, which is provided against by the longitudinal stays.

The two cylinders are connected in parallel, by a 3/8 in. pipe, to a main reducing valve which is a combination of a cut-out and diaphragm arrangement, and by means of this valve the gas pressure is reduced to some 2 lb. per sq. in. The gas then passes through a secondary valve into a flexible fabric container which operates as an expansion chamber, and practically as a governor. For instance, when the fabric chamber is fully extended it actuates a valve spindle which cuts off the supply, the surplus gas passing by way of a by-pass into the chamber of the reducing valve, which again cuts off the high pressure supply. Conversely, once the gas is emitted from the engine control valve the fabric chamber contracts and the series of operations is reversed so that a further supply is received from the containers. The system is particularly commendable in that it is entirely self-acting and demands practically no attention from the driver. The advances which have been made in the construction of valves for the purpose is shown by the fact that stuffing-boxes having proved unreliable have been replaced by seals formed by a combination of grease and rubber rings inserted beneath the valve body.

For recharging the London General Company will have in operation at their Cricklewood depot a Reavell compressor having a capacity of 15,000 cu. ft. an hour. This compressor will be coupled to a series of storage cylinders of 30,000 cu. ft. capacity, controlled by a hydraulic accumulator, which is introduced for the purpose of ensuring the maintenance of a constant pressure. The whole installation is to be so arranged that a number of omnibuses may be recharged simultaneously from a common pipe line. In the earlier days of gas traction it will be remembered that the opinion prevailed that the engine designed primarily for petrol (gasoline) consumption was capable of yielding with gas only some 85 per cent. of the maximum power obtainable with petrol; but it was then pointed out that were the engines designed for a higher compression the power ratio would compare very closely with that given for petrol. This appears to have been corroborated by experiments, for in a series of trials with the new arrangement it has been shown that the power obtained from the engine is equivalent to that obtained with petrol. The running figures which have been obtained are decidedly instructive in that they bear out previous estimates as regards the gas equivalent of petrol (in this instance the average relations being 280 cu. ft. of gas per gallon of spirit), while the average saving in cost, which is very considerable at low speeds, amounts to rather more than 50 per cent. as compared with petrol. The normal consumption of gas has been shown to be 35 cu. ft. per mile on a straight 10-mile journey.

As in the case of most gas vehicles the London General omnibuses are fitted with petrol supply arrangements for use in case of emergency. For this reason the ordinary petrol carburettor is retained. The change from one fuel to another is easily effected by engaging whichever throttle lever it is required to operate. A particularly novel feature of the new omnibuses is the use of gas instead of electricity for lighting. For this purpose a special reducing valve and governor are carried, the lighting supply being distributed at a pressure of 10 lb. per sq. in. Incandescent mantles are employed, and each is enclosed in a small fused silica protector. The merit of the system, however, lies in the fact that, whereas the usual electric generator installation weighs something approaching 3. cwt., the necessary apparatus for gas lighting runs to little more than 22 lb.—*London Times Engineering Supplement.*

THE SALVAGE OF THE ONWARD

Many interesting tales could be told of how the Admiralty Salvage Department have saved ships during the war. Some are romantic; others thrilling. But novelty, combined with mystery, attaches to the salving of the cross-Channel steamer Onward, which plied between a French port and a Southern port on the English coast. The boat was moored at the English port, and at about 11 o'clock at night, for no reason that could then be discovered, the fore part of the ship burst into fierce flames. In order to prevent the fire spreading to the quay the Onward was towed a little distance away and scuttled. She listed and rolled on to her side in comparatively shallow water. Then the salvage men got to work. Alongside the quay is a railway track, and the idea struck them of using locomotives to raise the sunken steamer. Strong wire ropes were fastened round the direlict bulk and worked through tripods fixed on the quay. These ropes were attached to the locomotives, which commenced the herculean task of literally dragging the big ship into an upright position. The five railway engines put on full steam and commenced to tug with all their strength. It was a tremendous struggle. The locomotives panted and strained, but for a time were unable to move. Eventually their combined efforts began to tell. The vessel was slowly heaved from her resting place, and with the aid of tugs kept clear of the quay and dragged into an upright position. She was patched up temporarily and towed to the Thames for repairs.

GRAIN DUST EXPLOSIONS AND FIRES*

Between March, 1916, and October, 1917, dust explosions caused the destruction of four of the largest grain and cereal plants in the United States and Canada. In these disasters 24 people were killed, 38 were injured and property to the value of $6,000,000 was damaged. One of these was an explosion and a consequent elevator fire in which was destroyed grain enough to supply bread rations for 200,000 soldiers for a year. During the same period of time a dust explosion occurred in a sugar factory, killing 12 persons, injuring 24 more and destroying almost $1,000,000 worth of foodstuffs and property. And such disasters are occurring continually. During the month of April, 1918, a carelessly dropped cigarette stub resulted in an explosion and the consequent destruction of a warehouse with its surrounding property, a total loss of $2,000,000. A few days later a flour mill, containing a great store of wheat, oats and barley, was destroyed by a dust explosion, which at the time was ascribed to the use of a blowtorch for babbitting a bearing.

HOW IT WORKS

If you want to start a fire in a stove, you do not try to set fire to a large stick of wood with a match. Nor do you stop at splitting this stick into smaller pieces. To get a good crackling fire immediately, you reduce one of your big sticks to shavings, touch a match to the bunch and off it goes.

Now, suppose these shavings were ground to a coarse powder, spread out in a thin layer, and ignited. You would find that your powder would burn very rapidly. If this powder were ground quite fine, and scattered about so that it became mixed with the air of the room, you could ignite it with a flame not even as large as that of a match. A very small electric spark, or a spark made by striking a piece of steel on a stone might cause this dust-laden air to take fire and burn so rapidly that it would produce an explosion. And wood dust is not the only dust of which this is true. Almost any kind of dust containing carbon explodes under favorable conditions. Among such dusts are grain dusts, flour dusts, sugar dusts, rice dusts, feed dusts, paper dusts, cotton dusts, leather dusts, wood dusts, cork dusts, and fertilizer dusts.

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*U. S. Department of Agriculture.

NATURAL GAS STORAGE*

By L. S. Panyity

The question of natural gas supply is receiving careful consideration in many parts of the country, as in the winter months it is quite a problem to have on hand sufficient gas to satisfy the demand. Increasing the output of wells by the application of vacuum has been tried with various results and large companies have attempted to keep up the supply with gas compressors. The possibility of storing natural gas in the sands of exhausted gas pools has been tried in a few instances with satisfactory results. This method may prove of practical value in solving the problem, especially in the case of towns that formerly obtained gas from their immediate vicinity, but now must search for new pools.

In all cases, only part of the available supply is utilized during the warm weather, so that many wells are shut in, yet during the winter months the supply is not sufficient even with all the wells on the line. In such cases it would be of great value if a large volume of stored gas were on hand, obtained through wells that would have been standing idle during the summer.

Idle producing wells having considerable "rock pressure" will force gas into the exhausted, or storage wells, and this gas will be used only when the regular supply falls short, Fig. 1. If two gas wells of different pressures are connected, the one having the greater pressure will feed the other, until the pressures are at an equilibrium. The same results will be obtained if an exhausted gas well is connected to a high-pressure gas line. High-pressure lines equipped with regulators near the town plant have considerable pressure, so that storage wells connected to such a line will receive gas from the line as long as the line pressure is greater than the well pressure. During a period of heavy consumption of gas, the pressure on the main line is greatly reduced, so that gas from the storage wells will flow into the lines. An arrangement of this kind will work automatically, the flow of gas into or from the storage wells depending on the pressure carried in the line.

It is advisable in most instances that the flow into and from the storage wells be regulated by means of gates, instead of automatically. In addition, the volume of gas should be metered as it is forced into or passes from the wells; the pressure also should be noted. By properly charting the meter and pressure records, the characteristics of the individual wells may be determined.

The geological conditions existing in the storage field, as well as in the producing field, must be taken into consideration. Best results are obtained where the storage reservoir is in

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*Trans. Am. Inst. Mining Engineers.

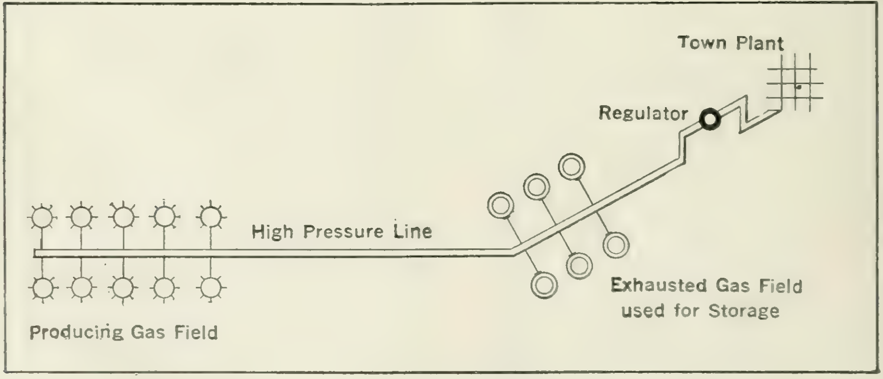


FIG. I

a shallow sand and the producing horizon is deeper, so that the producing sand will have a higher pressure. This will have a tendency to reestablish the original rock pressure in the artificial reservoir. It is unlikely that a rock pressure greater than that which existed originally can be obtained. A lenticular-shaped sand body is preferable, as good control over the entire reservoir is necessary. The location of all wells that have been drilled must be known and put in such a condition that they may be used; if this is not possible the wells must be properly plugged.

In some instances the sand used for storage may make large quantities of water; a difficulty that may be overcome by pumping. Best results are obtained by drilling a pocket below the sand in which the water may accumulate and from which it may be pumped through the working barrel, in the same way as it is customary to pump oil; the storage and recovery of the gas being through the casing-head, Fig. 2.

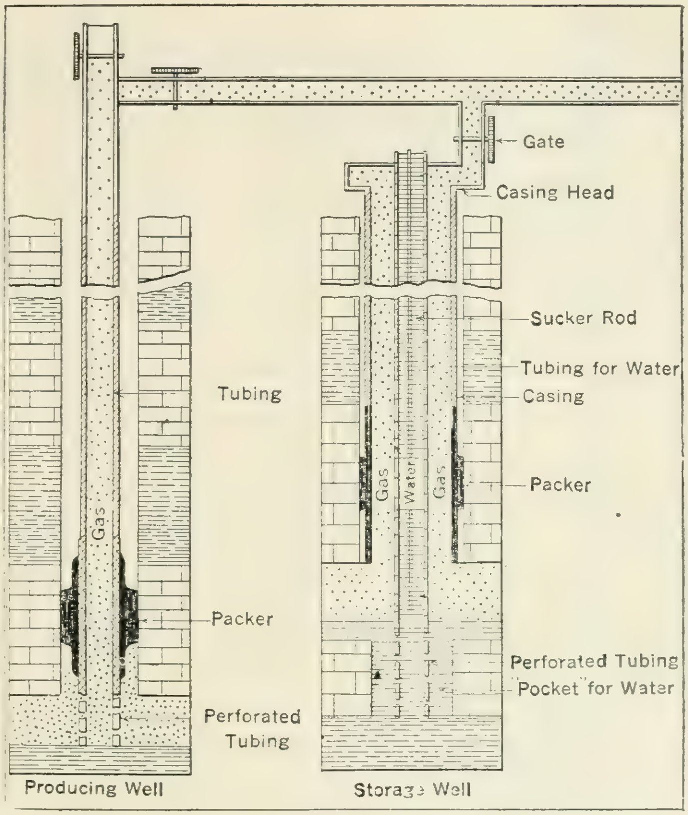


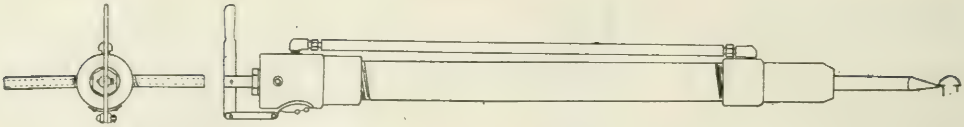
FIG. 2

This storage method may be used to advantage in many towns; for instance, Tiffin, Ohio, formerly the center of a large gas-producing area, but now dependent on outside sources, which in times of great demand are not sufficient for the needs of the town. It may be possible to find nearby an exhausted gas pool in such condition that this method may be tried. The system allows considerable latitude and may be installed to suit the requirements of the particular case.

An Emergency Placing of Pumping Equipment, aggregating a total capacity of 20,000,000 gal., was completed in 24 hr. at the Old Dominion mine, in Arizona, according to its report for 1917, with the exception that the transfer of a cable from one shaft to another was not finished.

HOW WETTING COAL IMPROVES COMBUSTION

Another characteristic of Iowa coal which is common to many low-grade fuels, is that wetting the fuel improves the combustion appreciably. It is not to be understood that the addition of water helps combustion from a chemical standpoint, but it certainly does from a physical standpoint. The water should be added at least two hours before firing so as to be absorbed thoroughly by the fuel. The physical action is three-fold: First, the sifting of coal through the grate is diminished; second, the fuel bed is made more compact; third, the steam generated by the moisture in the coal cracks open the pieces of coal, presenting new clean surfaces for quick combustion. These advantages more than offset the detrimental effect of excess moisture, which of course must be evaporated and superheated up to the temperature of the gases escaping from the boiler.—*T. A. Marsh in Power.*



PNEUMATIC RIVET BREAKER

The cut above shows a device which probably should be called a pneumatic sledge rather than a pneumatic hammer. It is for knocking or cutting off the heads of boiler rivets at a single blow and was designed, and since patented, by A. M. Roberts, tool foreman of the Bessemer & Lake Erie shops at Greenville, Pa. It has proven a complete success and there are 23 in the car yards at that point.

No description seems to be required. When being operated the lever is normally in the reverse stroke position and remains there until the workman pushes the handle forward when it strikes a blow on the chisel that will cut off any rivet up to an inch and a quarter. A rivet catcher, not here shown, is attached to the chisel for catching the heads of the rivets when cut off.

CUTTING TORCH RESCUES A SUBMARINE CREW

An extraordinary story of the salvage of a British submarine which went down in Gaenloch lock near the Clyde was recently cabled by the Associated Press. The submarine had seventy-three persons on board, including naval contractors and men from the yard where she had been built. The order was given to submerge and she was just beneath the surface when water began to pour into her aft and she descended stern down to a depth of fifteen fathoms. An inspection showed that the ventilating shaft had been left open and thirty-one persons in the rear of the vessel were immediately drowned. The forepart was shut off and the forty-two persons there were saved.

A few hours passed before divers were sent down on what they thought a forlorn hope so far as bringing any one up alive was concerned. Reaching the bottom, they discovered that the stern of the vessel was imbedded in many feet of mud. Knocking at the hull, they were amazed to hear a responsive tapping.

High-pressure bottles were brought into use and Captain Goodhart undertook, with their aid, to be projected through the conning tower and shot into the water with the hope of reaching the surface and giving information regarding those below. He was shot forward, but his head struck a beam and he was killed. Another officer volunteered and was fortunate to reach the surface and give information about the condition of the others below. Rescuers inserted through a water flap a flexible hose through which air, food and chocolates were passed. The entombed men asked, by means of Morse signaling, for playing cards "to beguile the tedium of waiting," as one of them said.

Strong wires were put around the vessel and the air bottles were utilized to blow out the oil fuel stowed forward, which enabled the vessel to drive upward until her bow was well above the water in a vertical position.

Immediately a big hole was cut in her with oxy-acetylene torches and the forty-two men were brought out and conveyed to an infirmary. They had been below twenty-four hours when Captain Goodhart made his attempt, and altogether the party was down fifty-seven hours before being saved.

To Captain Goodhart has been awarded posthumously the Victoria Cross.—*New York Times.*

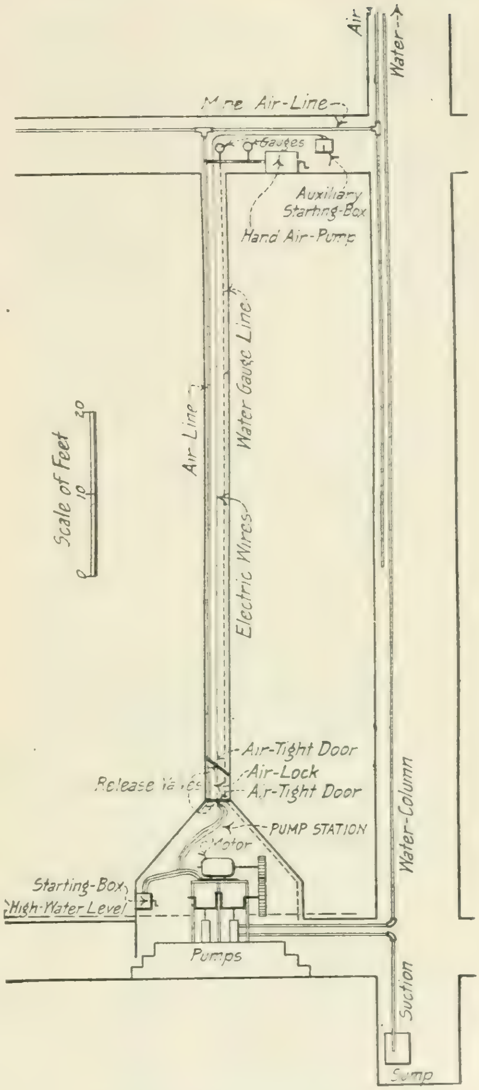
UTILIZATION OF AIR POCKETS

By C. Erb Wuench

During the unwatering operations at the Yak mine, in the Leadville district, it was noticed that in the backs of several old stopes air-pockets had been formed. Even though the water had risen considerably above the highest points in these stopes, the small cavities in the back were entirely unwetted. Such air-pockets have saved the lives of miners. This suggested to me the possibility of designing underground pumping-stations utilizing the principle of the hydraulic "diving-bell."

In the history of a great many mines that have been drowned it is on record that if only an hour or two more time could have been had in which to make the necessary repairs thousands of dollars of expense in unwatering might have been saved. In the Yak mine, owing to a sudden inflow of acid water that corroded the pumps of an intermediate pumping-station and caused an excessive flow to be handled by the pumps at the bottom, the motors burnt out. The sudden flow of acid water was due to the Moyer mine, an adjoining property, having been abandoned. There being no underground connection at depth the water, which was formerly handled by the Moyer pumps, backed up through the old stopes and took into solution the sulphates of iron and zinc formed by the exposure of sulphides to oxidation for a number of years, and then the waters charged with these sulphates found their way into the Yak mine and corroded the intermediate pumps.

By referring to the accompanying sketch, the general design of this style of pumping-station can be readily comprehended. The station is cut out so that the area at the back will be contracted as shown in the sketch. A raise will be driven from the back of the station to the level above. Through this raise an air-line and a water-gauge line and the wires to the auxiliary starting-box will pass. There will also be a ladder-way. At the bottom of this raise there will be two air-tight doors forming an air-lock. When everything is running smoothly, these doors will be open and the heated air, which is usually present in the back of a pump-station owing to the heat from the motors, will pass up the raise and fresh air come in at the bottom. This will have the minor advantage of having the electric motors working in a cooler atmosphere. In case anything happens to the motors or pumps, the lower air-tight door is closed, and as the water rises in the mine sufficient air will be admitted through the air-tight door to balance the water-pressure due to the rising water. The air may either be obtained from the mine air-line, or, if this is out of order also, the small amount of air necessary can be forced down through a hand air-pump as shown. Two gauges are provided: one, a water-gauge to measure the hydrostatic pressure of the water in the mine, and the other, to measure the pressure of the air that is forced into the pump-station to balance this hydrostatic pressure.

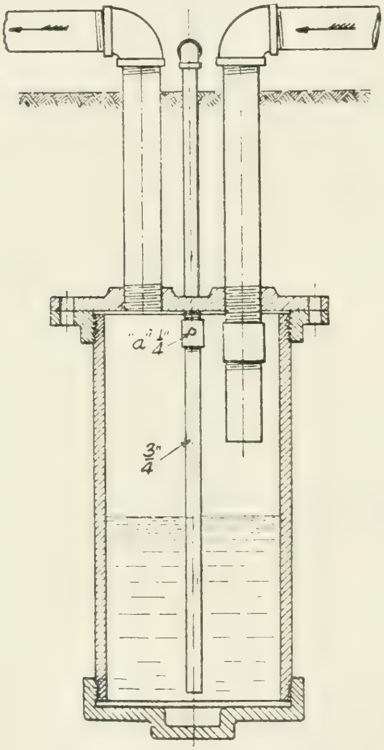


PUMPS LOCATED IN AIR POCKET

At the bottom of this raise is an air-lock. Men can go down the raise to the top of the pump-station, close the upper air-tight door, and by releasing the valve in the lower air-tight door they can gradually become accustomed to the pressure; then they open the lower air-tight door and pass into the station to make the necessary repairs. It can be seen that the men can work for a considerable time before the pressure will become too great for their lungs. The raise can be made large enough so that the various parts of machinery can be hoisted in and out of the pump-station.

When men are working in the pump-station under pressure, caustic soda (sodium hydrate) should be placed about the station to absorb the carbon di-oxide that is exhaled.

An auxiliary starter is shown in the sketch on the same level as the hand air-pump. This is merely used to start the motor to obviate going down the manway, passing through the air-lock, and thence entering the pump-station, in order to start the motors when the shut-down was due to power trouble.—*Mining and Scientific Press.*



DRAINING AIR PIPING FOR PNEUMATIC TOOLS

It will be remembered that in our December issue there appeared an article with the above title and the cut here reproduced will be recognized as having appeared in illustration of that article. It must be noted, however, that an important addition has been made in the cut as here shown. The change is very slight, consisting merely in the showing of a ¼ in. equalizing hole drilled in the side of the small air pipe near the top of the receiver. This is very necessary for the successful operation of the device. The article was from a Standard Practice Bulletin of the Emergency Fleet Corporation and the change is made upon information since received.

DUST ABATEMENT IN MINES*

By W. O. Borcherdt

Dust in mine air is dangerous and objectionable more or less in proportion to its silica content; and the well known diseases phthisis and silicasis commonly result from the continued inhalation of dust high in silica. It is not generally recognized that all dust is injurious, and that it should be the business of mine operators to suppress dust of any character, and to employ the same perseverance and intelligence which are, or should be, applied to the more obvious dangers due to faulty sanitation or unsafe practices. It is sometimes assumed that because high silica dusts are the most injurious, other dusts, unless present in quantities offensive to the senses, may be ignored. Figures have been advanced showing that the incidence of tuberculosis among coal miners is no greater than among surface workers in the same locality, and it has even been stated that the inhalation of local dust is supposed to confer a partial immunity to tuberculosis.

Those who are operating mines in which the rock dust is not siliceous, or in which it is siliceous to only a slight degree, have, of course, a less serious problem to face than those whose work is carried on in the highly siliceous rocks; but the dust problem exists none the less, and it behooves operators to recognize and solve it promptly and voluntarily, in order to make unnecessary eventual interference and regulation by the state.

NATURE AND EXTENT OF THE DUST EVIL

So far as I am aware, there has not been in this country any legislation directed at the dust evil which is as drastic as that of South Africa; but that conditions have existed, in certain parts at least, which paralleled those in the African gold mines is shown by the admirable work in the Joplin district.

(Continued on page 9051)

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*From a paper before the Seventh Annual Congress of the National Safety Council.

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ROSSITER WORTHINGTON RAYMOND

The following heart-full tribute to the memory of Dr. Raymond by the editor of *Mining and Scientific Press,* which we reprint entire from the issue of Jan. 11, will be read with high appreciation by all who know him, and it should commend itself equally to these who had not that high privilege.

On the last day of 1918 there died, at Brooklyn, New York, the most notable figure in the history of mining in America. Others may have directed bigger mining and metallurgical operations, others may have achieved a greater share of the success that is measured by money, others may have invented or designed a larger number of the methods or processes used in the winning of metals, but no man exerted so great an influence for so long a period of time as Rossiter Worthington Raymond—"the Doctor," as he was familiarly and affectionately known to the profession.

In the adult portion of his 78 years of life he saw the development of the American mining industry from a mere beginning to a majestic maturity; and in that development he played a notable part by the help and stimulus that he gave to two generations of men. He was the comrade of Clarence King, J. D. Whitney, James D. Hague, S. F. Emmons, and that earlier generation of scientific men to whom we owe the application of geology to mining and the systematic exploration of the continental area that was thrown open to the prospector as soon as the railroad joined the East with the West. He was the guide, philosopher and friend of the generation that followed, of many of the young men now directing the big enterprises of this country. He influenced the men that now influence others.

When he was born, in 1840, the mining industry of the United States had made a feeble start; when he went to Freiberg in 1860 there was no mining school in this country; when he served in the Union army the discoveries of gold in California and of silver in Nevada had laid the foundation for the mineral development of the West; and when he was Commissioner of Mining Statistics, from 1868 to 1876, he gave a lead to the application of science to the art of mining in America. Long the dean of the mining profession, he has been its spokesman from a time as early as most of us can remember. In him a profession usually inarticulate found an eloquent exponent; through him the public learned to appreciate the breadth of culture that is required by an accomplished engineer.

From his father, the editor of the New York "Times," he inherited his ability as a writer and an expositor, an ability that he developed to an effectiveness unmatched in our profession, not only as a public speaker, but in the more systematic duties of lecturer on economic geology and of editor of two mining journals, notably the "Engineering and Mining Journal," on which he collaborated for many years with Richard P. Rothwell. His abilities, however, were put to their maximum usefulness when he became Secretary to the American Institute of Mining Engineers in 1884. As editor, as organizer, as permanent executive, he managed the affairs of the Institute until his retirement in 1910, and so successfully that it became a national institution of the first rank.

He brought his vivid personality so actively into play, he marked the Institute so strongly with his own identity, that for 25 years it might with truth and credit have been known as the Raymond Institute. This condition had the defect of its qualities and eventually called forth the need for reorganization, to which he objected so strenuously that the last decade of his life was clouded by a controversy in the course of which he became estranged from several of his best friends. But that disagreement is now placed in its true perspective and is remembered only as the manifestation of an exuberant egoism not uncommon in great men. He was a great man, an inspiring figure of a man.

We like to think of him at the meetings of the Institute; how he would rise and look about him, then speak clearly, incisively, and humorously, making the rest of us seem a blundering lot of incompetents. He was the mainspring of those meetings; he saved the dullest from being a failure; he was ready for any exigency. This is not the occasion for touching upon the many other facts of his character: his legal career, for he was admitted to the bar; his church work, for he was superintendent of the Sunday-school, teacher of a bible-class, and preacher at Plymouth Church; of his skill in many ways, from playing chess to writing stories—he was amazingly versatile; these aspects of his many-sided personality demand more considered treatment than is permissible here. He had the gift of leadership, winning the devotion of old and young, of men and women alike; he was kind to those in distress and generous to those needing help, whether mentally or financially; he was religious in a glad and unaffected way; he was a maker of fun and of happy hours; he was an inspiring companion and a beloved comrade. For ourselves we tender to his memory the homage of a fellow journalist, the respect of a fellow engineer, and the affectionate remembrance of a friend.

A GREAT PNEUMATIC ENGINEER

Walter V. Turner, manager of engineering for the Westinghouse Air-Brake Co., died January 9. Mr. Turner was one of the foremost pneumatic engineers in the world, and had over four hundred inventions, covered by United States patents, in use on most railways of the world and in many large industrial plants. One invention alone: viz., the "K" triple valve, is valued at $28,000,000. In 1906 when the New York subway was taxed beyond its capacity and the formulation of some plan of relief became inevitable, it was finally decided to "speed up" the car motors. When Mr. Turner was consulted upon the subject he made the startling statement that relief could be obtained without any change other than installing his newly devised brake, which could produce a quicker and shorter stop than any brake heretofore employed. The new brake was tried and as a result the subway is operating with a triple capacity and is still satisfactorily providing for the traffic congested city of New York. The control valve adopted by the New York Central R. R. in 1909 and the universal valve, the first successful electro-pneumatic brake ever devised, by the Pennsylvania Railroad in 1913 are inventions of equal importance. Mr. Turner was an American citizen, but he was born in Epping Forest, Essex county, England. He came to the United States in 1888; became secretary and manager of Lake Ranch Cattle Co., Raton, N. M., in 1893; was engaged by the Atchison Topeka & Santa Fe Ry. in 1897, where he developed his first patent; and entered the services of the Westinghouse Air Brake Co. in

1903. He received the following appointments with the latter company: Mechanical engineer, 1907; chief engineer, 1910; assistant manager 1915, and manager of engineering, 1916.

MINERS' SAFETY AND HEALTH ALMANAC

The U. S. Bureau of Mines has published a useful almanac with the above title. It is a pamphlet of 48 pages, with one page for each month and safety hints or historical data for each day, sun's rising and setting, moon's phases, etc. In addition to this there is given a great variety of matter relating to health and safety, correct and comfortable living and other matters, making the book likely to be frequently referred to.

(Continued from page 9048)

Respirators do not, in general, present any hope of a solution, because they are objectionable to the miners, are partly effective only when properly cared for, hamper respiration, and will, therefore, be worn by only exceptional men or under conditions where unusually strict discipline can be maintained. To make such a provision effective it would be necessary for nearly all underground men to wear them. Moreover, ordinary respirators do not remove from the air dust particles less than five microns in diameter, and much of the dust which has been shown to be harmful is less than three microns in diameter.

WATER SPRAYS

Water sprays directed into the dust as delivered from the drill hole, and dust collecting bags intended to catch the dust and prevent its distribution through the mine atmosphere, have been constructed in many forms. It is my conclusion that none of these methods is effective on a practical scale. Elsewhere the opinion has been expresssd that the best hope for a practical solution of the problem lay in the use of drills employing hollow steel through which water is injected into the hole. This would appear to be the ideal method, because, as frequently pointed out, this type of drill not only allays dust, but gives a higher drilling speed. In some mines the conditions resulting from the operation of such drills have been entirely satisfactory, from both a hygienic and a mining point of view. In others, however, especially in those in which conditions demand overhand stoping and a large amount of raising in dry ground, the water feed drills have not been a success, partly because of mechanical imperfections, and largely owing to the attitude of the miners, who generally insist that they would rather breathe dust than get wet.

As the general features of this problem and the most practical methods for its solution have been covered in other papers and in the official reports of the South African and Australian Dust Commissions, it occurred to me that the best hope of contributing something of real value lay in the direction of determining the actual practical operating results with the various types of water feed drills in different mines under diverse conditions. For the purpose of securing this information I sent a questionnaire to 47 representative mines in the United States and Canada, to which 26 have made reply.

The data thus received have been tabulated and a summary of the table shows 11 instances of the use of respirators, only five of which were considered successful; four cases refer to raising, and one case refers to overhand stoping.

One operator suggests that improvements in respirators could be made by following the design of military gas masks; and, although it seems probable that a respirator could be developed along these lines which would be highly effective in stopping dust of even a few microns in diameter, the difficulty of getting men to use such respirators would be greater than is the case with the existing types, which, though less effective, are also lighter and not so objectionable.

A man cannot chew or smoke while wearing a respirator; and I think no one familiar with actual problems of protecting men from themselves and others will fail to agree with the statement that even men of more than average intelligence will not voluntarily and constantly use safety guards or precautions if these interfere with their comfort, convenience and fixed habits. This is unfortunate, but it is a fact, nevertheless. In practice it is not sufficient to point out the existence of a danger and the means by which it may be guarded against, but the men must be continuously and intensively educated in order to secure their co-operation in self-protection; and no amount of education will insure the adoption of a safety device which results in discomfort or inconvenience to the wearer. A sidelight on this problem is obtainable from the sand-blast art, where, originally, various types of masks and respirators were used, but in which present practice provides that the operator work on the outside of the chamber in which the sand blast is being used.

CONSTRUCTION OF RESPIRATORS

I have experimented in the construction of respirators containing a filtering element or cartridge which would be inexpensive, readily inserted and removed, and would have a filtering surface of such dimensions as to render violent exertion possible without distress. I believe that considerable progress is possible along these lines, and that, by the addition of an arrangement for humidification, it might be possible to stop even the finest dust. At best, however, I believe that the field of respirators is limited.

The use of dust-collecting bags is reported in three instances, which were unsuccessful, because all appliances so far produced have been a nuisance. The failure of water sprays is shown by the fact that, though reported in 29 instances, only one successful result is claimed—in connection with drifting, where the dripping of the water on the operator is naturally not as extensive as in overhand stoping and raising. Waterfeed hand drills—unmounted machines of the Jackhamer type—are extensively used. In drifting, four instances are given, three of which were successful; the other case was unsuccessful, because, as stated, the men prefer inhaling dust to getting wet, and because of mechanical imperfections in the machine. In underhand stoping, three instances are given, all successful, although objection was recorded in one instance on the ground that the safety precaution involved too much inconvenience. For sinking, nine instances are given, eight of which were successful. In the one unsuccessful instance the objections were that the steel sticks, that the machine cannot be rotated by hand, and that no dust is produced by dry sinking, anyhow. Evidently, because my questionnaire was not well worded, I failed to elicit any information either for this type of drill, or for others used in block holing. This I regret, because, in many mines, block holing undoubtedly contributes materially to the dust in circulation, as it is carried all over the stopes and often into the chutes, during shift; and, indirectly, because boulders are frequently blasted during the shift, with the consequent spreading of dust.

EXPERIENCE WITH DRILLS

The water-feed stoping drill is a machine of comparatively recent development. Mechanically it leaves more to be desired than any of the other modern hammer drills. It has great inherent possibilities; and to many operators it has seemed that designers and manufacturers have not fully recognized the extent of these possibilities, and have not given the question of the development of this type of machine the attention which it deserves.

In drifting, five instances are shown, of which four were successful. In overhand stoping, which would appear to be an ideal field for this machine, five instances are recorded, three unsuccessful, resulting in the comment that the men prefer dust to getting wet. Workers will not employ a safety device which causes discomfort or inconvenience, and no one should expect them to do so.

In raising, in 11 instances of the use of this type of machine three were successful. One of the successful cases is qualified by the familiar objection that the men prefer dust to getting wet; and that the machine has not been perfected mechanically; another comment was that the men will use the wet stoper if the wages paid are high enough, even if they do get wet. Of the eight unsuccessful instances, six were based on the grounds that the men prefer the dust to the water; another agrees to this and mentions the disadvantage of high maintenance cost; and still another supplements the same objection by referring to the frequency of the steel sticking, making rotation by hand impossible.

Two operators report the use of dry drills with auger steel for drifting or undercutting in soft ground. This type of equipment is recommended for these conditions by three operators, as being substantially dustless; and it is possible that this combination has not received the attention that it deserves, although it can be employed only under favorable conditions.

That the water-feed mounted drill is now the standard machine in most mines is clearly indicated in the table. In drifting, 22 instances, all successful, are shown, although in the case of one of these the machine is used in wet ground, and dust allaying is not considered one of its functions. In overhand stoping, of 11 instances nine were successful and two unsuccessful, the latter being due to mechanical imperfections and the fact that the men prefer dust to water. In underhand stoping, eight applications, all successful, are shown. In raising, nine instances are given, of which seven were successful, although one is qualified as partly successful, and one refers to use of the machine only if the ground is dry, but says that "the men prefer the dust to getting wet." In the two instances of failure this same familiar reason is given. In sinking, 12 instances, all successful, are quoted, one operator saying that the machines are used occasionally, but are not usually necessary; and another, that the water feature is not employed to allay dust.

USE OF THE WATER-FEED MOUNTED DRILL

To the man interested in safety alone, an examination of the accompanying tabulation would lead to one conclusion—that the water-feed mounted drill should be employed universally for drifting, overhand and underhand stoping, raising and sinking. Fortunately in some mines—instances of which are shown in the table—the dictates of mining economics appear to agree with those of safety. The water-feed mounted drill has been adopted for all purposes, and it is reported throughout as a successful machine. To what extent this conclusion represents the results of actual comparison I am, of course, not informed, but my own experience leads me to believe that in overhand stoping and raising, particularly in the latter, a properly designed water-feed self-rotating stoper would insure faster and cheaper progress than could be obtained with any mounted drill. In many overhand stopes the same would be true; and, even in drifting, the water-feed hand-rotated stoper is a much more formidable competitor, as compared with the mounted water-feed drill, than is generally supposed. There is reason to hope that, with the development of the former, much more effective work may be done in drifting than is now possible. It is these considerations which suggest that the manufacturers of rock drills should devote more attention to the development of this machine.

Some of the drills now available are convenient, light and extremely powerful, but their maintenance cost is high, and they contain details of design borrowed from machines intended for other purposes, which, under new conditions, cause difficulty and delay. In overhand stoping and raising, about the only advantage discernible, from the point of view of the operator, in the use of the mounted water-feed drill, as against the stope, is that the mounted machine is self-rotating, and it is not necessary for the operator to stand so close to the drill barrel; therefore, he does not get so wet as with the other machine. The operator of the hand-rotated water-feed stoper, owing to the necessity for hand rotation, has to stand close up, where he receives all the drip and spatter. With an automatically rotated stoper, this proximity to the machine would not be necessary.

IMPROVEMENTS IN DRILLS

So far as mechanical troubles which result from water and drill sludge running down the steel and into the working parts of the machine are concerned, there is no apparent reason why the same improvements in construction would not eliminate these difficulties also. That this is the thought of other operators is evidenced by the response to the request for suggestions for improvements. Three of these refer to the development of a perfected self-rotating water-feed stoper, and one refers to means for the reduction in the indiscriminate use of water in the machines engaged in overhand stoping and raising. A certain amount of water is required to allay the dust effectively. In many cases the design of the machine is such that much more water is discharged through the steel than is necessary, or water is released at other points, with the result that the operator is constantly sprayed, and the machine is condemned.

SUCTION VENTILATION IMPRACTICABLE

Ventilation by suction from the working faces would prevent the distribution of any quantity of dust through the mine atmosphere; but would be more expensive and difficult to apply. The problem of the ventilation of metal mines, comparatively speaking, is in its infancy; and many projects which might now be condemned as impracticable or too expensive will later become customary, as advanced practice or legislation suggests their adoption.

MACHINE MUST BE AS NEARLLY AS POSSIBLE "FOOL PROOF"

At present, conditions, rather than theories, must be faced. Mines must be made safe, regardless of whether the motive for doing so is lofty, or simply that of making a virtue of necessity. Few metal mines would show an atmosphere conforming, for example, to the South African regulations; and, as it is idle to talk longer of disciplining labor or of making the men do this or do that, it is obvious that the only solution possible is the use of drilling apparatus which will be inherently non-dust producing, and at the same time not be objected to by the men. In order to combine with these qualifications a drilling rate which will make it possible for the mine to operate, the machine must operate successfully, must be light, simple, durable, powerful, and, at the same time, as nearly as may be, "fool proof."

BURNING PULVERIZED COAL

By W. G. Wilcox*

The simplest view of the combustion of coal is to regard it as a reaction between fuel and oxygen. It is a heterogeneous system; consequently the velocity of the reaction and its completeness will depend upon the surface exposed by the solid, the pressure of the reacting gas, and the intimacy of the mixture. By grinding an inch cube of coal so fine that 85 per cent. will pass a 200-mesh screen, we have increased the surface exposure from six square inches to approximately 1,800 sq. in. Thus we have increased the velocity of combustion 300-fold. By doing so, we have changed the characteristics of the fuel. We now have a fuel relatively 300 times more active than the inch cube of coal, a new type of fuel that has in it inherent possibilities not to be found in lump or slack fuel. By increasing the surface of exposure 300-fold, we have speeded combustion proportionately. This carries with it a further effect. The increase in rapidity of combustion also increases the rapidity of heat evolution, and consequently quickly raises the temperature of the rest of the material. This rise of temperature, which is much more rapid than in the normal combustion of coal, will double the velocity of combustion for each rise of 10°C. The increased rapidity due to greater surface exposure and that due to temperature rise are superimposed, so that a pulverized fuel affords a combustion that is hundreds of times faster than when burning lump-coal.

ADVANTAGE OF MIXING COAL AND AIR

Having a finely-divided fuel it is possible to form a mixture of fuel and air so intimate that each small particle of coal is surrounded by the proper amount of air. In this condition, by maintaining the proper velocity of the air-current, the fuel can be carried into the furnace in suspension and there burned completely, efficiently, and rapidly.

It is, of course, a simple matter to mechanically control the amount of powdered coal delivered to the furnace in a given time. It is also possible to control the amount of air delivered with the coal. If, then, we deliver to the furnace an intimate mixture of air and powdered coal, and control the amount of coal-dust and air delivered, we have the prime essentials. The degree to which they are attained depends entirely upon how carefully we study the characteristics of the fuel before and during combustion.

The amount of coal-dust delivered can be controlled simply and positively by using a screw-feeder operated at variable speed. It is also a simple matter to control the volume of air admitted with the fuel; but the highest efficiency possible with this type of fuel will not be obtained unless we work out a correct way in which to mix a finely divided solid with the air.

INCORRECT MIXING METHODS

A study of the methods for making such a mixture immediately shows that the methods commonly used in making a uniform mixture of two miscible liquids or a uniform solution of a solid in a liquid, or the methods used in mixing finely-ground solids are not only useless in this case, but will actually separate the coal-dust from the air. Ordinary mixing is done by agitation; this agitation is usually accomplished by baffling, stirring, shaking, or similar devices. When, however, such methods are applied to a mixture of gas and finely divided solid, the solid tends to separate by reason of its higher specific gravity. This, in fact, is the principle of the well-known cyclone dust-collector. Any mixing device that produces such agitation of the dust and air as to give a centrifugal effect will tend to separate, not mix, the air and the dust.

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*From a paper before New York Section American Chemical Society.

The importance of mixing the coal-dust and air intimately cannot be exaggerated. The rapidity of combustion is a direct measure of the intimacy of the mixture. This is well illustrated by comparing the ordinary gas-flame with the flame obtained in the Bone combustion system, which consists in forcing the proper proportion of air and gas through a diaphragm having numerous interstices. When this mixture is ignited on the other side of the diaphragm, it produces a film of flame.

The poorer the mixing, the longer the flame. The flame simply outlines the area in which combustion is taking place and the length of the flame is a measure of the time element necessary to accomplish combustion. This time element—other conditions being equal—is absolutely a function of the intimacy of mixture, as was noted by Breckenridge 10 years ago, when in Bulletin No. 325 of the United States Geological Survey, he stated:

"The conclusion is reached that the velocity of combustion decreases enormously from the surface of the fire to the rear of the combustion-chamber, where it is relatively very small, the practical application is that little is to be gained by adding further length of smooth combustion-chamber, which would be commercially as poor an investment of capital, as to add to the length of a Corliss engine-cylinder and stroke; we must resort to thorough mixing."

Just as in the past there has been a remarkable failure to realize the necessity for intimately mixing air and coal-dust, so there has been insufficient consideration of the characteristics of this fuel when burning. Powdered coal has the characteristics of a rich fuel of somewhat higher kindling temperature than producer-gas, natural gas, or fuel-oil.

VELOCITY AND PRESSURE

The rapidity of combustion and the completeness of combustion of a mixture of coal-dust and air depend upon a number of factors: for example, they are dependent upon the velocity and pressure at which it is passed into the combustion-chamber. If the velocity of the incoming stream of powdered coal and air is above the velocity of flame propagation combustion will not take place until the mixture has slowed down to a point that it does not exceed the velocity of flame propagation. When a powdered coal is fired at high pressure and high velocity, combustion frequently does not begin until a point four to six feet from the mouth of the burner. A similar example is found in the plumber's blow-torch when too much air is used, or in the Bunsen burner when the gas-pressure is too high. High-pressure firing not only slows down combustion, thus increasing the size of the chamber necessary, but has a destructive action on the furnace. It has been well established that high velocities in the combustion-chamber or a blow-torch effect due to firing at high pressure (whether oil or gas be used as a fuel) are always destructive of the brickwork. This action is increased in high-pressure firing of powdered coal, since, in addition to the erosional effect of gases at high temperature traveling at high velocity, there is a fluxing action by the melted ash. Furthermore, the slagged ash will be carried along mechanically, leading to further furnace troubles. In one case this resulted in a deposit of slag on the muddrum of a vertical waste-heat boiler at the end of a long reverberatory furnace. Slowing the velocity not only hastens combustion, but makes it possible to eliminate much of the slag. When the velocity is low the coalesced particles of slagged ash are either larger than will be carried by the velocity of the gas or this condition is so nearly approached that a slight change in direction of the flame will result in dropping out the slag. Thus, in addition to being correct combustion and necessary in order to avoid excessive furnace-maintenance costs, low-velocity combustion, by a slight change in flame direction, permits the dropping out of a large quantity of the slagged ash in the early part of combustion, where it can be removed and will not interfere seriously with efficient metallurgical operations.

The velocity of combustion is not only dependent upon the fineness of the particles of coal, the intimacy of the mixture, and the velocity of the stream of combustible and air, but is affected by the temperature of the combustion-chamber. The kindling temperature of a mixture of powdered coal and air is higher than that of either oil or gas; consequently for successful and complete combustion, it is necessary that the combustion-chamber be maintained above a certain minimum temperature and that the combustion be practically completed before the products of combustion pass over the heat-absorbing surface. Just as you can extinguish a gas flame by passing over it a piece of wire-gauze, so the effect of a chilling surface will be even more marked with this combustible material than with burning gas, since the particle of coal is infinitely larger than a molecule of gas and the kindling temperature is also higher. This has a direct application to the successful firing of locomotive boilers, water-tube boilers, and return-tubular boilers. If the combustion of powdered coal be not sufficiently developed before the flame enters the tubes of the locomotive boiler, combustion will be checked and coked coal settle out in the tubes. If, on the other hand, combustion be sufficiently developed before the flame is brought in contact with the heat-absorbing surface, complete combustion and high efficiency are obtained.

A study of the flame developed at a low pressure by an intimate mixture of coal-dust and air shows that combustion is extremely rapid. In a copper-reverberatory furnace at Florence, Colorado, where this type of combustion is used, coal burned at the rate of approximately one ton an hour develops a flame that vanishes within six feet of the burner, combustion being complete at that point. Let us translate this into terms of natural gas, in which case the fuel consumption would be approximately 26,000 cu. ft. per hour or 433 cu. ft. per minute. You can picture to yourself this quantity of gas being burned at low pressure and developing a flame only six feet long. Samples of gas taken in the flame show a content of CO_2 as high as 16 per cent only five feet from the mouth of the burner. This will give an example of the rapidity with which combustion can be obtained and the possibilities of shortening the flame. With proper equipment it is equally practicable to lengthen the flame until it will spindle out a distance as great as 100 or 120 ft. However, with an intimate mixture under control, this must be done by supplying insufficient air. Under such conditions combustion is incomplete and the flame spindles out because combustion continues to develop throughout the length of the furnace as air-leakage supplies additional oxygen. This is proof of the statement that the length of flame is an actual measure of efficiency of mixing and the adjustment of the fuel-air ratio.

ADVANTAGES OF POWDERED COAL

Thus, it is seen that we have changed entirely the characteristics of coal as commonly known. Powdered coal is a fuel of extreme flexibility, in that the amount burned can be varied within wide limits. It is a fuel that develops a flame whose length can be adjusted. The character of the flame can be altered to suit the metallurgical operation. In short, the basic fuel, coal, has acquired the characteristics of oil or gas, but with better and closer control. Furthermore, the possibilities of this fuel are not only capable of realization, but are actually being utilized in commercial practice today. To the flame characteristics of a rich fuel, developing a flame like oil or gas, is added a degree of control not yet obtainable in burning either oil or gas. This statement is made advisedly. The possibilities of such combustion for the improvement of processes, for fuel economy, for increasing output, through its ease of control and elimination of heavy labor, are realized by few. Owing to the attitude of labor and the scarcity of skilled operatives, it is far more difficult than ever before to secure high efficiency and good operation in hand-firing, stoker-firing, or in producers, in short, whenever such efficiency depends upon constant watchfulness and hot, heavy, disagreeable work. For these conditions powdered coal substitutes an ease of control so simple that a man of ordinary intelligence can soon be taught all that is necessary for good efficiency in operation, or it can be handled by an old man or boy. The possibilities of such control in the place of present-day combustion methods, which permit high efficiency only by the most strenuous effort, through substituting for these a type of combustion whereby high efficiency is easily obtained, are certainly of great importance to us at the present time.

NOTES

Bottoms of Mine Cars may be cleaned by means of a drill of the jack-hamer type, fitted with a flat or wedge-shaped bit. The operator manipulates the machine with a short "scooping" motion to loosen the material, which is afterward removed with a short-handled shovel.

Now that the war is over, we should have an exhibition of the freak inventions offered to the Government. If to this could be added the really useful inventions, which were accepted and proved of value, it would be a most enlightening source of education.

Compressed air from a compressor should not be used for cleaning relays when blowing out the switchboard. Air may be blown into the relays, making them inoperative. A bellows answers the purpose for cleaning the relays.—*Electrical Review.*

Fuel oil and crude oil are not the same, even though they are often used interchangeably. Fuel oil is the residue left after certain of the lighter constituents of crude oil have been removed by partial distillation. Thus, fuel oil has a greater specific gravity than the crude oil from which it is obtained.

A writer in *The Scientific American* states that common salt is an efficient decarbonizer. First get the engine warm and in easy starting condition. Then remove the spark plugs and pour a teaspoonful of common salt into each cylinder. Replace the plugs and start the engine and "the carbon will pour from the exhaust."

Claiming that the Oliver Iron Mining Company for ten years has been using an ore washer on the basic principles of which he holds the patent, Captain Alexander McDougall, an inventor and president of the McDougall-Duluth Shipbuilding Company has brought suit for $40,000,000 against the mining company.

The chairmen of 88 draft boards, after conferences with representatives of the Illinois Manufacturers' Association and the Association of Commerce, authorize the statement that there will be jobs waiting for the 175,000 soldiers and sailors who entered the service from Chicago when they return. Those who do not receive their former positions will be promoted to better ones, it is said. The men will be provided with transportation to Chicago after they are mustered out.

Military planes flying above an altitude of 10,000 ft. are equipped with an apparatus for supplying oxygen to the flyers. It was proved by the English air casualties that 90 per cent. of the accidents was due to the flyers suffering from lack of oxygen. The device was designed by Lieutenant Colonel Dryer of the British R. A. M. C., and works under variable tank pressure from 100 to 2250 lb. per square inch with a temperature range of from 70 deg. to 80 deg. F. to 20 deg. or 30 deg. below zero.

The world's largest producing oil well, which in the last eight years has been known to maintain an average production of 50,000 barrels per day, totaling more than 100,000,000 barrels during the time of its existence, suddenly started spouting salt water. Although there is still a large percentage of crude flowing from the well, nevertheless it is believed this marks the beginning of the end. The well is the Mexican Eagle Oil Company's Potrero No. 4, in the Tampico district, Mexico.

Two French chemists, Francis Labriel and Raoul Oesgorge have invented a process, it is stated, whereby milk can be converted into a fabric which may be used for clothing and ornaments. By means of chemical treatment, curds resulting from this process can be reduced to a plastic substances which may be rolled into sheets resembling celluloid. This product can then be made so soft that it may be used as a substitute for silk in the manufacture of fine underwear or in its solid state can be converted into buttons, etc.

A non-inflammable gas, officially termed "argon," for the use of balloons and dirigibles has been discovered, which will eliminate the hazard of fire and explosion that always has accompanied balloon operations where hydrogen gases have been used. The gas from which argon is obtained comes from wells at Petrolia, Tex., owned by the Lone Star Gas Co. A pipe 94 miles long is proposed to be laid from the wells to a plant at North Fort Worth, where the gas will be compressed into cylinders for shipment to the balloon fields.

The highest temperature ever recorded by the U. S. Weather Bureau shows a maximum of 134° F. established at the Greenland ranch in Death valley during the month of July, 1913.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

NOVEMBER 5.

1,283,472. APPARATUS FOR LIQUEFYING AIR AND SEPARATING IT INTO ITS CONSTITUENTS. Charles F. Crommett, Chelsea, Mass.

1. In an apparatus of the character stated, means for compressing and cooling air, means whereby the compressed air is divided into three portions, means whereby one of said portions is caused to liquefy the second portion, and means whereby the third portion is caused to evaporate the liquid produced from the second portion of said compressed air.

1,283,502. GAS-PRESSURE REGULATOR. Jacob C. Groble, Anderson, Ind.

1,283,524. VACUUM FUEL-FEED DEVICE FOR AERIAL-VESSEL ENGINES. Webb Jay, Chicago, Ill.

1,283,529. FAN-PUMP. Henry Kleckler, Buffalo, N. Y.

1,283,565. ELECTRIC VACUUM - CLEANER. George T. Robinson, Bowling Green, Ky.

1,283,593. METHOD OF AND APPARATUS FOR COMPRESSING FLUID. Robert Suczek, Philadelphia, Pa.

1. The method of compressing elastic fluid, which consists in partially compressing the same by ejector action in each of two stages, and in the first stage entraining and compressing said elastic fluid by elastic motive fluid of such quantity as to cause in the first stage a ratio of compression not less than the ratio of compression in the second stage.

1,283,644. COMBINATION VACUUM CLEANER AND SWEEPER. Charles A. Boyer, Warsaw, Ind.

1,283,769. ATMOSPHERICALLY - RESPONSIVE DEVICE. Nels Hofstad, Chicago, Ill.

1,283,823. APPARATUS FOR GASIFYING LIQUID GASES. Fortunato Levy, Paris, France.

1,283,981. ELECTROPNEUMATIC BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,284,000. AIR-VALVE FOR FLUID-PRESSURE BRAKE SYSTEMS. Frank H. Weimer, Nogales, Ariz.

1,284,033. LIQUID-FUEL BURNER. Clarence H. Allison, Chicago, Ill.

1,284,053. SMOKE-CONSUMER. William L. Briggs, Gadsden, Ala.

1,284,147. CONTROLLING MEANS FOR PNEUMATIC APPARATUS. Guy M. Russell, Rochester, N. Y.

NOVEMBER 12.

1,284,220. LIFE-BELT. Paul Bergen, Richwood, Wis.

1. In a life-saving appliance of the class described, a box-like generator having a gas chamber, material in said chamber adapted, when subjected to water, to generate gas, a water chamber, and a valve normally open and subject to gas pressure in the gas chamber to cut off communication between the water chamber and gas chamber.

1,284,225. FLUID-OPERATED DEVICE. Fred H. Bogart, Philadelphia, Pa.

1,284,336. SYSTEM OF DISTRIBUTION FOR HUMIDIFYING, HEATING, AND AIR-CONDITIONING APPARATUS. William B. Hodge, Charlotte, N. C.

1,284,361. CRUDE-OIL BURNER. Bernerd W. Kelly, Somerset, Ky.

1,284,530. PNEUMATIC SUPPORT FOR VEHICLES. William G. Wood, Sacramento, Cal.

1,284,594. LIQUID-ELEVATING APPARATUS. Edward Christman, Massillon, Ohio.

1,284,614. PNEUMATIC ENGINE-STARTER. John E. Desmond, Detroit, Mich.

1,284,662. CENTRIFUGAL PUMP AND COMPRESSOR. Reginald F. Halliwell, Rugby, England.

1,284,705. AIR-DRAFT MOTOR. Charles Kappel, Chicago, Ill.

1,284,926. ATOMIZING METHOD FOR MAKING FORMS AND CONTAINERS FROM FIBROUS COHESIVE SUBSTANCES. John P. Raymond, San Francisco, Cal.

1. The method of making fibrous forms and containers consisting of the steps, first, agitating a mixture of fibrous pulp and water, second, atomizing a column of said mixture, and, third, in conducting into a porous mold by the action of air pressure said atomized mixture for the purpose of forming a contiguous layer of pulp of any desired shape and thickness free from moisture.

NOVEMBER 19.

1,284,964. REFRIGERATING APPARATUS. August P. Anderson, Chicago, Ill.

1,285,101. PERFUME-DISPENSER. Freling C. Foster, Jr., Chicago, Ill.

1,285,302. MOLDING-MACHINE. Charles P. Melvin, Youngstown, Ohio.

1,285,391. PNEUMATIC MATTRESS. Charles B. Robertson, Columbus, Ohio.

1,285,396. PNEUMATIC ACTION OF PIPE-ORGANS. Charles F. Rowe, Chicago, Ill.

1,285,415. VACUUM-COOLER WITH INTERIOR ABSORPTION. Paul Schou, Copenhagen, Denmark.

1,285,417. MACHINE FOR MAKING MOLDS. Theodore C. Schultze, Grand Rapids, Mich.

1,285,420. BOTTLE - BLOWING MACHINE. James P. Scull, Millville, N. J.

1,285,484. LOCOMOTIVE-BLOWER. Axel S. Vogt, Altoona, Pa.

1,285,487. DRAFT-ACCELERATOR AND VENTILATOR. John J. Wagner, Green Cove Springs, Fla.

1,285,552. PROCESS OF EXHAUSTING AIR FROM THE PRESENCE OF FOOD PRODUCTS. Arthur Barry, Liverpool, England.

1,285,557. AIR-GAGE INDICATOR. Edgar Boyd Camp, Anaheim, Cal.

NOVEMBER 26.

1,285,586. TORPEDO-LAUNCHING APPARATUS. Frank Baker, Broadview, Saskatchewan, Canada.

1,285,618. PNEUMATIC WHEEL. James A. Carter, St. Louis, Mo.

1,285,649. AIR-BRAKE-CONTROL SYSTEM. Frank H. Dukesmith, Meadville, Pa.

1,285,808. COMPENSATING AIR-PUMP FOR PNEUMATIC VEHICLE-WHEELS. Harry C. Schroeder, Berkeley, Cal.

1,285,824. PREPARATION OF METAL NITRATES. Walter O. Snelling, Long Island City, N. Y.

1. The process that comprises treating a sulfid-containing liquid, under sub-atmospheric pressure, with an acid capable of reduction by hydrogen sulfid.

1,285,952. LIQUID-FUEL BURNER. Dudley de Ros, Islington, England.

1,285,968. VENTILATOR UNIT. Frederic A. Finegan, Flushing, N. Y.

1,285,975. PNEUMATIC ACTION. Robert A. Gally, Cincinnati, Ohio.

1,286,052. MILKING-MACHINE. Benjamin J. Miller, St. Paul, Minn.

1,286,099. VACUUM-CLEANER. Frank B. Rae, Cleveland, Ohio.

1,286,115. SUCTION-CLEANER. William W. Rosenfield, New York, N. Y.

1,286,119. AIR-PRESSURE GAGE. George A. Sagaser, Hanford, Cal.

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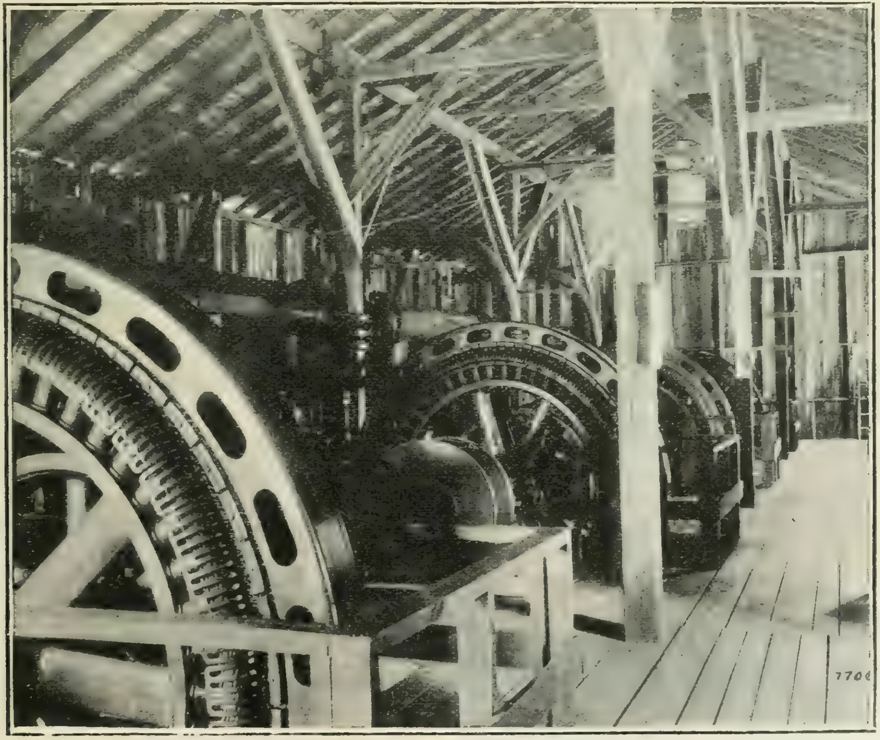


HARDAWAY CONSTRUCTION COMPANY, WHITNEY, N. C.

CONTRACTOR'S COMPRESSED AIR PLANT

By W. L. Saunders

The increasing importance of compressed air plant equipment in contracting has been the natural outgrowth of the contractors' development of methods, which demanded the introduction of tools of great ruggedness and high capacity. The success of certain characters of work, as for instance, pneumatic caisson foundation sinking, the shield method of driving subaqueous tunnels, are entirely dependent upon compressed air. It may, therefore, be safely said that compressed air plant forms an essential part of the contractor's equipment, and the problem resolves itself entirely into one of the selection of that compressed air plant which will best meet his needs.

PRACTICAL APPLICATIONS

The more prominent classes of contracting employing compressed air equipment comprise the following group:

Rock Excavating

Tunneling, Shaft sinking, Road building, Foundation work, Aqueduct construction, Canal excavation, River and harbor improvements, Subways.

Structural Steel Construction

Reaming, Pneumatic riveting, Drilling, Pneumatic concrete placing, Pneumatic caisson foundation sinking.

Railroad Work

Pneumatic tamping of ballast, Spike driving, Wood boring.

Sewer, Gas and Water Main Construction

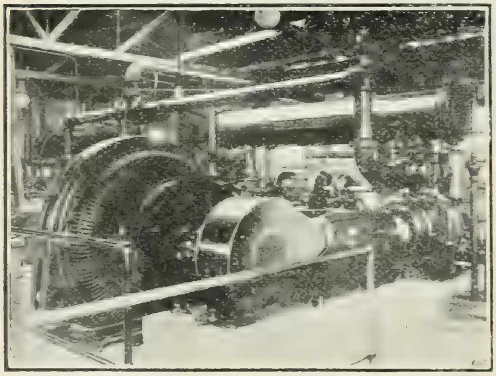
Rock excavation in trenching, Pipe caulking, Riveting, Tamping back fill.

Quarrying

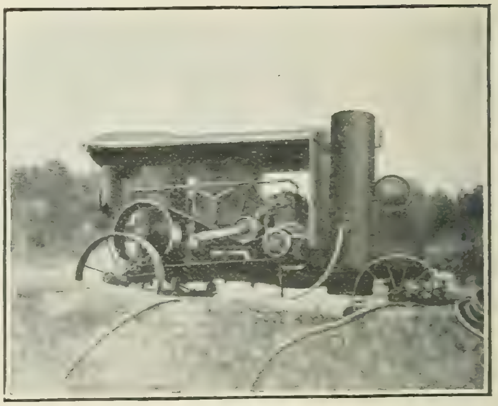
Excavation of rock for dam building, road surfacing, concrete structures, etc.

TYPE OF COMPRESSOR

The character of the work is an important feature in the determining of the size and the selecting of the type of air compressor plant; for instance, such work as tunnel driving, aqueduct construction, canal excavation, etc., might well utilize a number of semi-permanent air compressor installations, like those used by the Hardaway Construction Company, as such work usually extends over a considerable period of time. On the other hand, such work as road building, open cut excavation, trench digging, structural work, etc., could more profitably employ portable air compressor plants which move with the work, like that used by the Georgia Railway and Power Company.



HOLBROOK, CABOT & ROLLINS



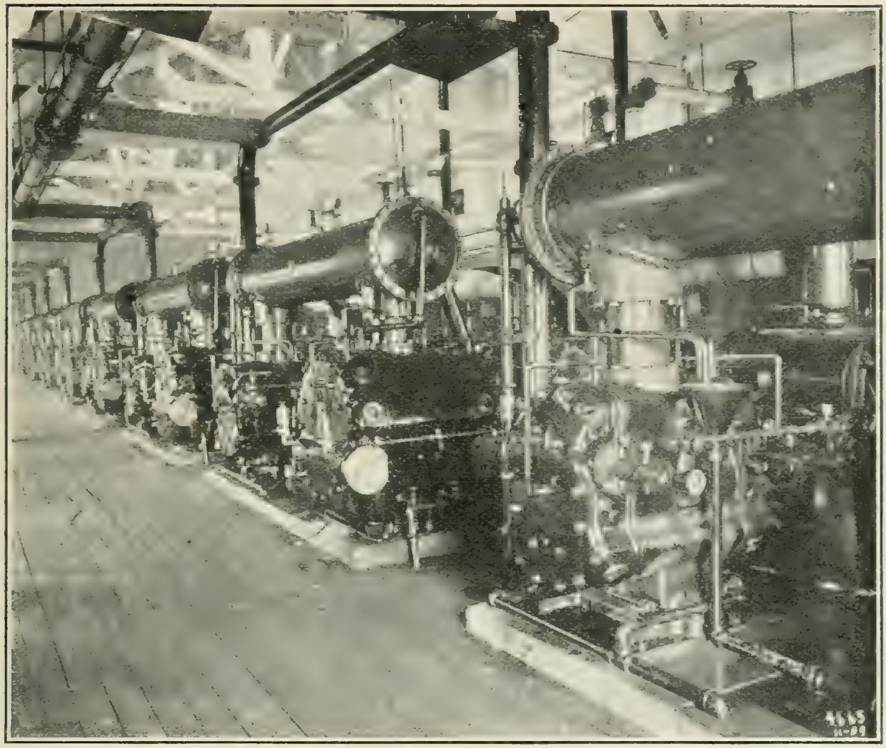
GEORGIA RAILWAY & POWER CO.

In the case of semi-permanent installations the requirements may call for the installation of both high pressure and low pressure units, the former for purposes of operating rock excavating machinery, pneumatic placing of concrete, the operation of water pumps, hoisting engines, pneumatic riveters and the like, as were used at Shaft No. 2, Brooklyn, by Holbrook, Cabot & Rollins, and the latter for supplying air to pneumatic caissons and tunnel shields, as used by Flynn & O'Rourke at Jeannette Park.

The availability of motive power will be a deciding feature in the selection of the type of air compressor, for instance, where the work is of considerable magnitude and remote from a supply of cheap electric current it becomes necessary to utilize steam driven air compressors, as installed by the T. A. Gillespie Co., with a boiler plant, which makes it more or less a permanent installation. On the other hand, where electric power is available, either direct connected electrically driven type of air compressor of the Rogler Class, where the requirements for air is large, or the short belted to motor type air compressor, Imperial type, where the requirements are small.

AIR OR STEAM PLANT?

In earlier practice it was customary to operate rock excavating machinery by steam, utilizing the boiler horse power direct, and



T. A. GILLESPIE & CO. TEN IMPERIAL CORLISS COMPRESSORS

thereby eliminating one item in the initial cost of equipment. On the other hand, the development of efficient steam operated air compressors and greatly improved compressed air operated rock drills caused the contractor to realize that he could effect more efficient and economical operation by installing an air compressor, than he could by adhering to the now admittedly obsolete practice. The greater loss experienced in the transmission of steam over long distances, as compared with that of air, and the greater consumption of boiler horse power in the rock excavating machine per unit of work, as compared with compressed air drills, more than compensated for the additional initial outlay.

OPERATING POWER

In some isolated cases where hydro-electric power could be generated on the job, the question of choice of compressor motive power is a simple one. A notable instance of such practice is that of the Laramie Pondre irrigation tunnel driven in Colorado, where Pelton water wheels were installed for driving generator sets, supplying current to short belt motor driven Imperial air compressors.

For portable compressed air plants, the choice of motive power falls naturally to gasoline driven types, due to comparative lightness of the equipment, the simplicity of operation and the ease with which satisfactory oper-

FLYNN & O'ROURKE

ating labor may be secured. On city street work it is sometimes advisable to use a motor driven portable unit, securing electric power from trolley lines or commercial power circuits. In building construction the semi-portable skid-mounted motor driven units are customarily employed.

SELECTION OF COMPRESSOR

In the selection of the air compressor, the contractor should give attention to the question of permanence of the equipment or its possible salvage value, as in the case of a large project involving the installation of an elaborate plant, upon its completion he may have no further opportunity to utilize a plant of such large capacity, and it therefore becomes necessary to salvage it. On the other hand, a portable unit invariably becomes a permanent part of his equipment. This presupposes that a high-grade plant will be in better condition upon completion of a job, and therefore return a greater salvage value.

As a case in point, a recent instance will be mentioned. In August, 1913, the E. E. Smith Contracting Co. of New York City purchased an Imperial Two-Stage Air Compressor and Receiver, and again in July, 1914, a duplicate unit. The total outlay involved an expenditure of $4,128. Upon the completion of its subway contract in June, 1916, the Smith Company disposed of these machines for $3,100. They estimated that the compressor plant had cost them practically nothing, and therefore had the use of compressed air on this job at a comparatively low cost. This particular installation was of the short belted to motor type, and in this connection it is well to bear in mind that in a unit of this sort, the changing from one contract job to another involving a change in electrical current conditions makes it necessary only to substitute one standard motor for another.

The volume of the work to be performed will determine the number of tools it is necessary to use, and this in turn will determine the size of air compressor to purchase.

AIR CONSUMPTION

Manufacturers of rock drills and other pneumatic appliances for contracting, publish figures of air consumption at various pressures, and it is, therefore, comparatively simple to determine the amount of air required to operate a given number of tools. To this should be added a margin of safety, as invariably the contractor finds many other adaptations for the air. This margin of safety will vary from 10 to 20 per cent., depending upon the magnitude of the undertaking.

INSTALLATION

With semi-permanent installations it becomes necessary to provide suitable housing and foundations of semi-permanent character. The question of housing is a simple one, the only precaution required is the protection of the plant from the elements. With work of long duration, it is advisable to install a foundation of mass concrete or stone masonry structure. This is particularly true of large machines. Machines of small and moderate capacity customarily employed on short time jobs give satisfactory service bolted to skid foundations, firmly anchored.

On penalty jobs, or in such work as pneumatic caisson sinking or shield tunneling, where the lives of the workmen are dependent on the absolute uninterruption of the air supply, it is imperative to install duplicate units, so as to insure against failure of the power supplied.

The radius of distribution of compressed air from a central station is practically without limit.

EQUATING COST

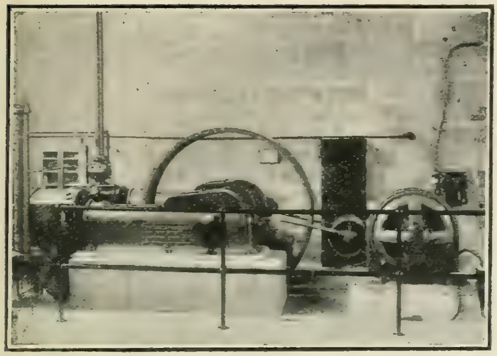
The determining factor is the balancing of the comparative cost of the installation of one large plant and the cost of transmission line necessarily large in diameter, plus operating cost, with the installation of smaller units with smaller transmission lines, plus operating cost. In the transmission of air over long distances, the cost of the air line installation may reach a point where it will more than pay for the installation of a number of small units and give more satisfactory service.

TRANSMISSION

Transmission lines will vary from 2 to 6 in. in diameter, depending upon the size of the installation and the distance of transmission. Suitable control valves should be provided at the power house, as well as the points of outlet.

In pneumatic caisson work an aftercooler forms an essential part of the air compressor equipment, it being utilized to remove the heat of compression and deliver the air to the air locks at normal temperature.

In the operation of pneumatic tools of various kinds, particularly in cold weather, some



SHORT BELT DRIVE

trouble may be experienced from freezing, and under such circumstances it becomes advisable to install some form of air reheater, which not only eliminates this trouble but increases the power delivered by the air compressing plant.

A properly designed air transmission line should include the installation of moisture traps at convenient intervals for the removal of the moisture, which the air contains and which is deposited in the transmission line.

MAINTENANCE

Modern air compressors have reached such a high state of refinement that aside from an occasional inspection to insure tightness of stuffing boxes, absence of leakage in the transmission line, and the proper functioning of the lubricating devices require very little attention on the part of the operator. Most machines have their driving parts automatically splash lubricated with force feed pumps supplying the cylinders. Air compressors for permanent or semi-permanent installation vary in size from 50 to 10,000 cu. ft. of free air per minute, pressure ranging from 15 to 125 lb. Portable air compressor plants range from 50 to 500 cu. ft. of free air per minute at similar pressures.

TAMPING "PLUMS" WITH JACKHAMERS

In building the Copco dam on the Klamath River in northern California, concrete was placed in the foundations through shafts, some of which were 125 ft. deep. Because of the limited space in the smaller shaft sections, hand tamping was slow and ineffective, interfered with the other work, and cost about 10c. per cubic yard. The specifications were exacting in regard to well-compacted concrete, and endeavor was made to improve on tamping by hand. Pneumatic tampers were tried out, and after some attention to details the tamping cost was reduced to 5c. per cubic yard.

The smaller shafts were in sections about 16x50 ft. in plan, and this space was divided by the cross-bracing into 8x16-ft. sections. In these small sections the men shoveling concrete, placing plums and tamping were frequently in the way of one another, and when the concrete was coming at normal speed it was often extremely difficult to tamp it properly.

When tamping by hand, about 100 to 150 cu. yd. of concrete were placed per day, and six to eight men were engaged in tamping. It was found that the hand tamping accomplished very little in the way of compacting the concrete where the layers were more than 3 in. in thickness, and in no case could the concrete be compacted uniformly. When a pneumatic tamper was adopted to the work, however, it was possible for four men to tamp effectively a day's run of 300 cu. yd. or more of concrete. The pneumatic tamper could not be applied directly on the concrete itself without burying the tamping head, but by tamping the plums it was found possible to compact the concrete for a depth of 2 ft. in all directions under the plum. The principal problem connected with adapting the jackhamer used to the work of tamping the plums was to find a suitable tamper head. The first attempts were with a hemispherical piece of steel about 5 in. in diameter and ½ in. thick, whose concave side was riveted or welded to an 18-in. shank of ⅝-in. hexagonal drill steel. These tamper heads would last long enough to tamp 250 to 300 cu. yd. of concrete, after which the rivets or the weld would loosen so that the head would come off. A more successful type of tamper was built by up-setting the head of a longer piece of drill and working it into the shape of a cone with a base about 3 in. in diameter. This type eliminated the difficulty of the tamper head coming loose, and gave good service for 400 to 500 yd. of concrete. It has a weakness, however, in that the shank would finally crystallize and break off just where it enters the jackhamer. But with such heavy service long life for the steel was not expected and the economies over the hand method much more than offset the maintenance costs.

The work was carried out by the California-Oregon Power Co. forces, P. O. Crawford being resident superintendent in charge of construction and installation.—*Eng. News-Record.*

STRAIGHTENER MADE FROM OLD AIR PUMPS

By Claude T. Rice

In the machine shop of the Hecla mine at Burke, Idaho, there is a formidable-appearing as well as a much-used machine called the press or straightener. This machine was made several years ago from the air cylinder of an old compound 10x18x6x18-in. Jeanesville mine pump that was about to be sold for scrap. The cylinder is mounted vertically upon a base, which is an old compressor disk 52 in. in diameter and 6 in. thick. The water-end piston rod of the pump has been forged out into a plunger, and a lever arrangement has been mounted upon the valve chest so as to control the flow of air to the cylinders.

There are several different pieces that rest on top of the base to act as anvil blocks when pressing pulleys, etc., on and off shafts or axles, but one of the main uses of the press is in straightening old rail and pipe. By using a 4x4-in. steel bar, 4 ft. long, for a straightening block, and holding the pipe by means of discarded clamps from 6-in. rock-drill bars, and clamping one at the top of the pipe directly under the plunger, pipe up to 6 in. diameter can be straightened. For straightening rails, the same 4-in. bar is used shimmed up with thin pieces of iron. The rail is placed on this block and straightened 4 ft. at a time, working it back and forth under the plunger. As the bend in the rail is generally sideways, blocks are arranged so that pressure is brought upon the head and web of the rail rather than on the flange, and a steel block is put under the plunger so that it will press only against the head and web of the rail. The machine serves a useful purpose in salvaging old pipe, rails, and bar iron.—*Eng. and Min. Journal.*

ONE HEADER SUPPLIES ELEVEN DRILLS

One 3-in. air hose was made to supply eleven drills, in shaft sinking, by feeding to the suspended metal "header" hung from a cable in the center of the shaft just above the bottom being drilled. Even eleven 14-ft. hose lines led off from the bottom of the header. There was also one connection for a blowpipe. Eleven drills were operated and two drills were kept as spares. When all was in readiness for blasting, the header and hose were hoisted out of danger, and were lowered again when drilling was resumed. A round of 45 holes, averaging 8 ft., were drilled in 2½ to 3 hours. The 11x21-ft. shaft was sunk for the Seneca Mining Co., Mohawk, Mich.mfwy cmfwy cmf cmf ing Co., Mohawk, Mich.—*Eng. News-Record.*

LOCATING THE AIR INTAKE

By Mark Meredith

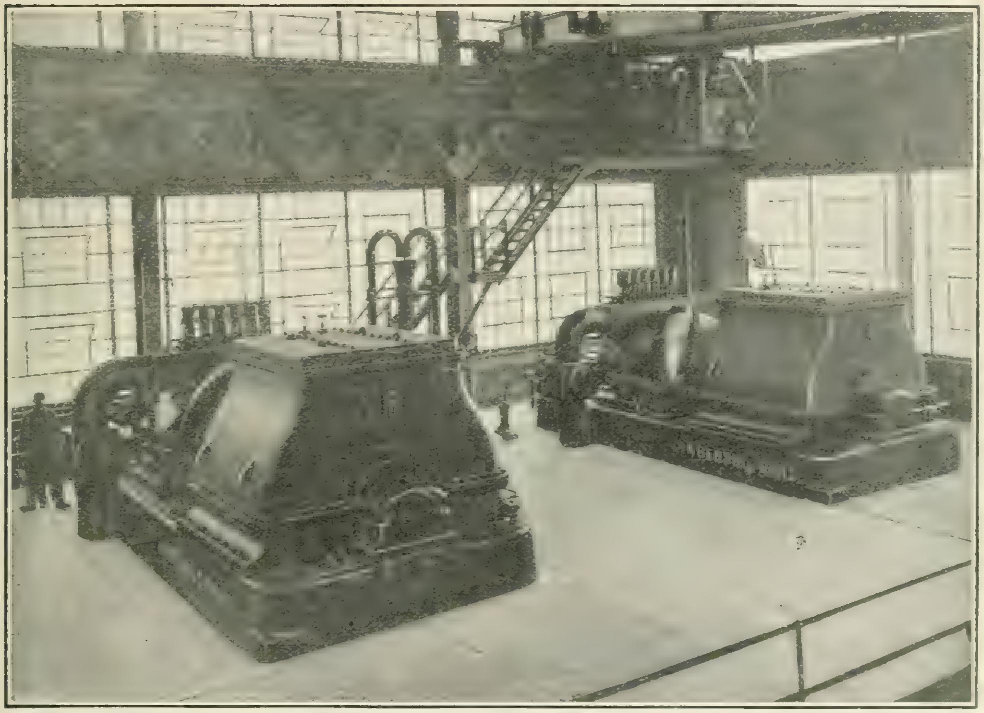
Some time ago a small belt-driven vertical air compressor was installed in a certain boiler room where there was considerable dust due to the handling of coal and ashes. It was necessary to extend the 1½-in. inlet pipe outside of the building. As the unloader was of sensitive construction, and as the least bit of dirt would make the pistons stick, causing poor regulation, considerable power was wasted because of the safety valve on the receiver releasing continually.

It was desired to connect the pipe as direct to the compressor and with as few fittings as possible, which located the end of the suction pipe between the eaves of three roofs. To keep it free from water and other obstructions a hood was made from 6-in. galvanized sheet metal pipe with a 2-in. galvanized pipe nipple. These parts were all taken from used material found about the factory. This arrangement has worked satisfactorily for about a year, and it has never been necessary to clean out the unloader nor has there been any trouble from poor regulation.—*Power Plant Engineering.*

THREE-STAGE COMPRESSION FOR COTTON BALES

Raw cotton is at present loosely compressed at the gin into what is known as the "Plantation" bale with a density of about 12 pounds to the cubic foot. Only about 25 or 30 of the plantation bales can be loaded into a standard 36 foot box car. When the bale has been carried to town and sold it undergoes another compression to a density of about 22 pounds to the cubic foot. This is known as the

"Recompressed" bale, and will load 60 to 65 into a standard 36 foot car. If the bale is consigned North by coastwise steamer, or for export, it moves by rail or by river steamer to the nearest port where it takes a third degree in compression to from 32 to 35 pounds per cubic foot. This is called the "High Density" bale and will load from 100 to 150 bales into a standard car.

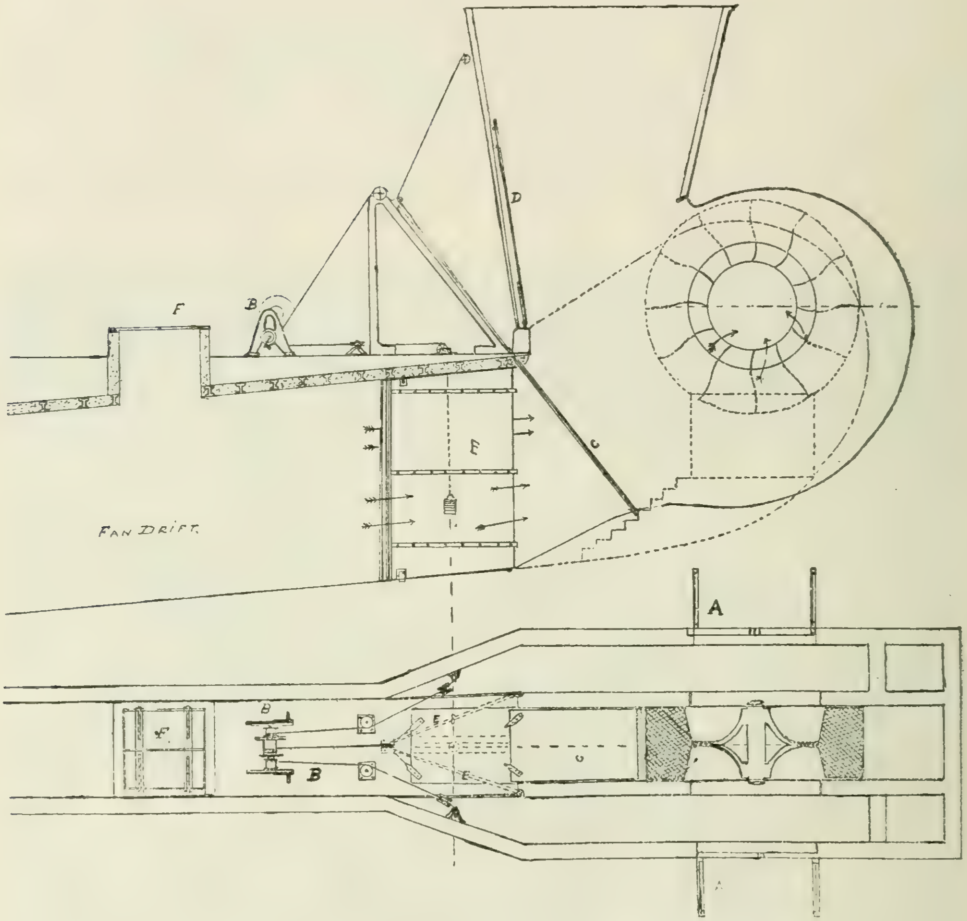


TWO TURBO COMPRESSORS AT MARK PLANT, INDIANA

LARGE STEAM TURBINE DRIVEN TURBO BLOWERS

The excellent photo here reproduced shows the turbo compressor or blower installation in the power station of the Steel & Tube Company of America at Mark Plant, Indiana. As will be seen, there are here two turboblowers each with a capacity of 55,000 cu. ft. of free air per min. These deliver the air at a gage pressure of 13 lb., this being conducted through an aerial line outside the power house to the blast furnace for the furnace draft. Each unit comprises an Ingersoll-Rand, 3,000 h.p., 2,500 r.p.m. uniflow steam turbine and a 5-stage blower. Liberal space is provided around the machines for dismantling and the entire area is commanded by the electric traveling crane seen in the background. Removable sections in the floor give the crane access to pumps and auxiliaries below.

A considerable quantity of compressed air at the ordinary working pressures is required for various service about the mills. To furnish the air for the district adjacent to this power house there is installed on the basement level an Ingersoll-Rand 10 in. and 14 in. by 10 in. duplex compressor of approximately 600 cu. ft. free air capacity, equipped with unloading valves. This compressor is driven by a 100 h.p. slip ring induction motor with short belt drive. The motor is provided with magnetic control arranged in connection with a pressure switch. When the pressure drops to 85 lb. the motor starts and the compressor runs until a pressure of 105 lb. is reached, when it stops. A storage and receiver tank of 500 cu. ft. capacity is used in connection with this equipment.



ELEVATION AND PLAN OF VENTILATION REVERSING SCHEME

REVERSING MINE VENTILATION

By J. Fox

Arrangements for reversing the ventilating currents of a coal (or any other) mine in case of a fire, or large outflows of noxious gases, have been strongly recommended by members of the Royal Commission on Coal Mines. This very important point has received the attention of Dr. J. S. Haldane, who in a paper on the possibilities of rescue work in connection with mine fires and explosions of gas and air, laid great stress upon the quick reversal of the ventilation in many cases as the best means of reducing the loss of life in such disasters.

The fan now under consideration (see illustration) affords quite a simple and effective means of carrying out Dr. Haldane's suggestion: to reverse or keep reversed (if already done so by an explosion) the ventilation of any district or mine. Owing to the great simplicity of the arrangement this, could be effected by anyone in charge without fear of failure, and without entering either the fan drift or fan house.

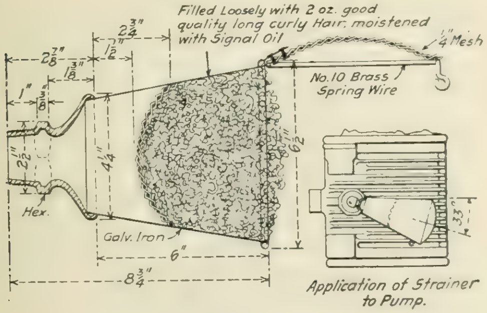
In following the description given, it will be seen that the change from an exhaust to a blowing ventilation is simplicity itself.

Every mining man knows that the reversal of any system of ventilation requires very great consideration before it is decided upon, and must be worked out. and experimented upon under normal working conditions, to find out what would take place (and what should be done) under abnormal conditions so that there should be no doubt about its action when taken. If the above provisions were in use it would not require a very competent person to decide to move a lever, and so reverse the current. The arrangements work as follows:—

A marks side doors fixed in the fan walls and only requiring to be opened immediately before the reversal of the ventilation is to take place. To reverse the ventilation open the doors A, then turn the winch handle B three and a half times, this at once actuating every part of the reversal gear in a complete ratio. By raising the sliding front C the covering is lowered, by the same movement, into the chimney of the fan D, and the same process gradually brings across the junction doors E, to the sides of the two former inlets, thus at once closing up the original intakes of the fan. Moreover, the doors E, in passing from the junction centre of the fan drift, at once give a clear passage for the reversed air through the doors A, the sliding front C, the junction doors E, and on into the former upcast shaft. All the various changes are made in one operation by turning the winch.

As mentioned above, it is well known that in most explosions of gas and air, there is a reversal of the air current; and by actuating the winch, as described, it would be most simple to keep the reversed current in that condition, so as to clear the foul gases out of the mine before making any change in direction; for if the air were restored to its normal course before the deadly gases were thoroughly diluted or cleared away, the latter would be sent back into the workings and claim a second lot of victims, who have, perhaps, only just survived the first deadly current from the one explosion.

It is most important that energy should be directed to affording some means that will get rid of the deadly gases that are always given off from the disastrous accidents always imminent in coal mines, and the quicker the gases mentioned above are diluted or cleared away, the fewer will be the casualties.



AIR BRAKE PUMP STRAINER

In support of the arguments put forth above concerning the loss of life through CO, the chief product of such disasters, the following figures, obtained after the Hulton Colliery disaster, may be quoted:—

CAUSE OF DEATHS

CO responsible for......	220	deaths.
Effects of explosion......	54	"
CO and explosion.......	61	"
Asphyxia	2	"
Others causes	7	"
	344	

Much the same results were found in many disasters, including Maypole, Hamstead and Whitehaven. It will be seen that the largest loss of life is caused by CO, and to minimize these risks it is quite feasible to alter the fans at present in use, and in all new undertakings adopt such reversal fans as will do what is described. This will enable a better control of the ventilation, which, under the old order of things, often got the upper hand.

The author has had experience of fires in mines where the victims have lost their lives through the effects of CO, and it was through experiences of this kind that the protected device here described was designed.—*Collery Guardian.*

STRAINER FOR AIR BRAKE PUMPS

By E. A. M.

A simple air pump strainer, much more effective than the ordinary type which has so long been used, is shown in the drawing. In making it the casting from the old type strainer is used, and in this is inserted a cone-shaped tube of sheet metal 6 in. long by 6½ in. outside diameter at the large end. A concave screen of ¼-in. wire mesh is inserted in the tube and soldered in place 2¾ in. from the inner end. The remainder of the strainer is loosely filled with curled hair, about two ounces being required for this purpose. The outer end of the strainer is closed with a hinged lid of ¼-in. wire mesh, soldered to a light brass wire frame. A slot in the side of the tube is provided to take the latch formed on the end of the wire lid frame. In order to provide sufficient spring for the proper operation of the latch, about two inches of the frame at the latch end of the wire is left unattached to the netting. The lid is hinged to the strainer at a point opposite the latch.—*Railway Mechanical Engineer.*

REVERSED HEADS IN PRESSURE VESSELS

By James Leslie Lane

In the pioneer days of the boiler industry, when but few mathematical data on such work were available and when inspection was almost unknown outside of perhaps one or two of the larger cities, it was but natural that the reversed head should have been used. Pressures were low and strength was less important than tightness. The advantage of backing a head in was obvious. It made riveting and calking much simpler, did away with a manhole that would otherwise have been necessary, and in cases where the drum was to be stood on end avoided the use of a cast-iron base or supporting framework. There was little machinery for manhole cutting or flanging, and as this had to be done entirely by hand, the cost was considerable.

Later, when pressures increased and laws were enacted covering the construction and installation of boilers, some of the objectionable features of this practice became apparent. When the tank was set vertically, it was found impossible to drain it completely; for if the outlet was placed in the center of the head there was always water remaining below that level. Locating the outlet close enough to the bottom of the shell to remedy this fault was not only difficult, but left an opening that soon became clogged. The second drawback was that this dead space served as a settling chamber and mud catcher, where oil and sediment could collect. This feature was bad as there was always a chance that the oil would eventually find its way into the boilers and cause serious trouble. This was overcome in time by demanding that tanks so constructed should be set horizontally. But there were other difficulties to contend with, especially in regard to strength.

The matter of calculating the ultimate bursting pressure of a head inserted in the regular manner, and hence its safe pressure, is not a difficult problem, although it is somewhat complicated by the fact that a bending moment is introduced at the point where the flange and the head proper join. This causes the head to breathe slightly under excessive pressure, but the error it introduces into such calculations is not serious. The case of a bumped head resisting collapsing pressure is far more difficult, however, as it is somewhat analogous to buckling in bars. If the cross-sectional area of a bar is known, as well as the tensile strength, its ultimate rupturing strength can be accurately determined. What the same bar will do under a compressive stress depends on its shape, length, manner of applying the stress, etc. The formulas for determining its resistance to buckling are mostly empirical; that is, deduced from actual experience and tests. The same is true of bumped heads, the number of factors introduced and the uncertainty of their action making a clear-cut and exact mathematical formula out of the question.

Not a little hinges also on the individual workmanship and the accuracy with which the head is shaped to a given radius. Before collapse can begin, some small part of the head must be flattened by the pressure. This is difficult if the curvature is exactly the same at all points on the sphere and the stresses set up in it are balanced; but if in the beginning some small portion is left flat and a leverage afforded the tendency to collapse is cumulative. In fact, it might be said with fair accuracy that in every case where such failure occurs under pressure the beginning was made at a flat spot.

Where the pressure is on the concave side, such a fault tends to correct itself by forming the head to a circle; in a reversed head it tends to accentuate itself and lead to a failure of the whole. Accurate workmanship cannot, therefore, be too strongly insisted upon. Installing a badly shaped head is analagous to putting into a building columns that are already buckled and out of true. Both invite failure and should not be tolerated.

These faults, the impossibility of deducing an accurate formula for collapsing pressure and the practical certainty of imperfect curvature, have been allowed for by stipulating that such heads shall have a minimum thickness considerably greater than would be the case if they were put in the regular manner and the pressure applied on the concave side. These restrictions take care of the stresses set up in

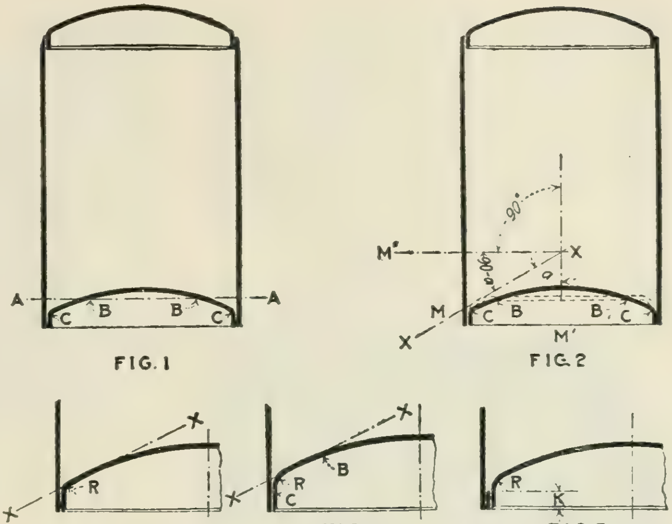


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5

THE REVERSED HEAD IN THE AIR RECEIVER

the head itself, but do not allow for the effect of breathing or swaying on the shell.

Turning to Fig. 1, observe what form the bumped head will first assume when a distorting pressure is applied, and what stresses it will develop in the shell. The problem is similar to buckling in a beam, and whatever distortion appears will be about the neutral axis *AA*, no effect being noticeable at the points *B* where the axis cuts the head.

If the part *BB* is to bulge outward finally, it must first be flattened, the part *BC* of the head being distorted and assuming the shape shown in Fig. 2. This places the part *BC* in compression and the stress will be exerted along the tangential line *XX*. Without attempting to determine the exact intensity of this stress, assume it to be M pounds and resolve it into its two components, one parallel to the axis of the shell, the other at right angles to it.

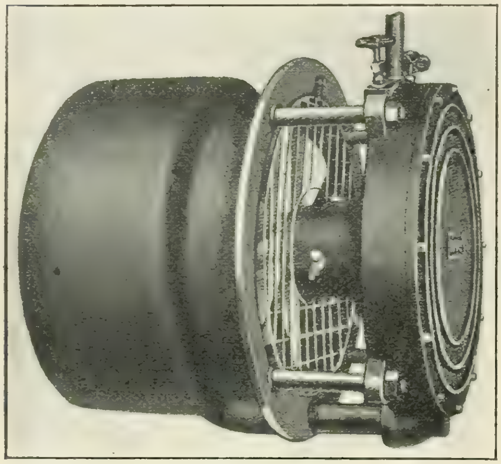
Supposing that the line *XX* makes an angle a with the axis of the shell, then the force M' acting parallel to the axis of the drum will be M cos a and its effect will be wholly exerted on the rivets holding the head in position. The force M'' acting at right angles to the axis of the drum will be M cos (90 deg. a) and its effect will be partly exerted on stretching the metal in the part *BC* of the head, and in expanding the shell of the drum itself. To put the problem in a simpler way, the action is a toggle effect, the outer rim of the head being stretched and forced out against the shell, tending to rupture it.

Just how much of this toggle effect is brought to bear on the shell of the drum depends on the radius *R*, where the head meets the flange. If the radius is small, as in Fig. 3, then any expansion of the head must affect the shell, for the thrust comes directly against it. On the other hand, if this radius is large, as in Fig. 4, the part *BC* of the head is free to spring and the stretching of the shell is minimized. This would lead to the conclusion that in reversed heads the radius at the knuckle of the flange should be considerably larger than in the case of straight dished heads of the customary type. In order to reduce still further this toggle effect, the writer believes it would be advisable to insert a filler piece between the flange of the head and the drum, as shown in Fig. 5. It need not be thick —probably one-eighth inch would be sufficient —and where possible it should be of copper. Its width *K* should not exceed 2½ in., in order that a clear space be left above to take care of any expansion of the head.

Summing up, then, the advantages of a reversed head are: (1) The possible elimination of a manhole where the drums are small; (2) the elimination of a cast-iron base or supporting lugs where the drum is to be set in a vertical position; (3) the possibility of doing the riveting on a bull.

Opposed to these are the following disadvantages: (1) The impossibility of proper draining, with the attendant danger that oil may find its way into the boilers; (2) the settling chamber formed, and the danger of clogging the outlet pipes; (3) the additional thickness of plate required; (4) the wholly empirical formulas on which such plate thickness must be based; (5) the ever-present element of danger due to faulty curvature; (6) the additional load that such construction puts on the shell joints.

This latter list is a formidable one, and where safety is a necessary factor to be reckoned with it far outweighs any initial saving in construction. The defects are too glaring, and in offering the foregoing suggestions the writer does not mean that such changes would entirely eliminate them, but would rather minimize their effect in cases where such doubtful practice is adopted.



COPPUS TURBO BLOWER

TWO TURBO BLOWERS

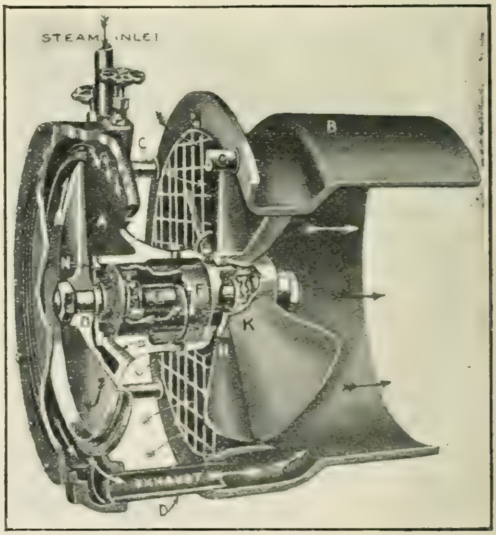
A considerable demand has developed for self contained unit blowers capable of reliably delivering considerable volumes of air at slight pressure. These are used for producing draft in boiler furnaces and for various ventilation service. The two examples here illustrated are both steam driven and in many respects resemble each other.

THE COPPUS TURBO BLOWER

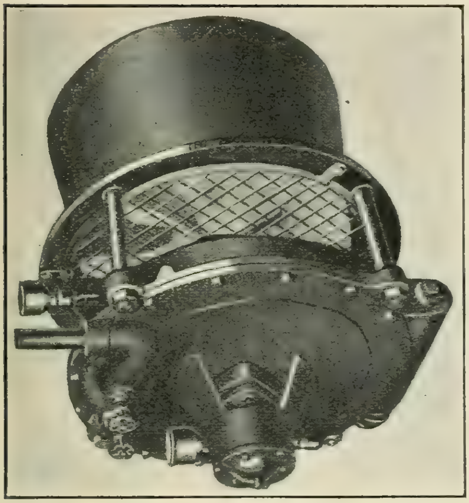
This blower, built by the Coppus Engineering & Equipment Company, Worcester, Mass., has the following features of construction: The casing *A* is supported from the fan casting *B* by studs *C* and the exhaust pipe *D*. The shaft *E* with its ball bearings is mounted within the motor bushing *F*, which is provided on both ends with enclosures. The complete motor is inserted bodily into the housing of the turbine casing and forms with it the oil chamber *G*. The oil ring *H*, which hangs from the shaft into the oil chamber delivers the oil constantly to the bearings, after which the oil is returned to the chamber. The shaft carries one one side the turbine disk and on the other the fan. Provision is made for sealing the turbine casing so that no exhaust steam or water can enter the oil chamber, while the oil chamber is also sealed to prevent oil from leaking out. When the oil chamber is filled the oil level is approximately at the center of the balls of the bearings and the two upper oil chambers on each side of the dam form with the lower oil chamber *G* an enlarged reservoir. As long as the oil supply does not diminish, the function of the oil ring *H* is simply to create a circulation of the oil through the ball bearings.

When the oil supply diminishes, the original oil level in the upper oil chambers is still maintained so long as the oil ring touches the oil in the lower oil chamber *G*. To fill the oil reservoir the plug *L* at the top of the hub of the turbine casing is removed and the overflow pet cock at the side of the casing is opened. When oil flows through this pet cock it is closed and the plug *L* replaced. When it is desired to clean or refill the oil chamber, the plug *M* is removed.

To facilitate repairs the bearings are mounted in the motor bushing which is inserted in the hub of the turbine. If any of the moving parts of .the machine should need attention the bushing can be removed as a whole.



DETAILS OF COPPUS BLOWER



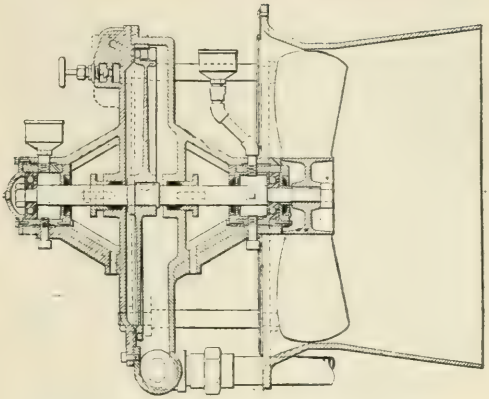
CARLING TURBO BLOWER

The casing closely hugs the fan and is expanded immediately beyond. This relieves any choking effect on the air by the casing, eliminates friction and prevents the formation of eddy currents.

THE CARLING TURBO BLOWER

In this machine the fan casing is said to be constructed on the Venturi principle which allows a free flow of air, gives high efficiency and makes the blower practically noiseless. The turbine casing is constructed with a safety ring in combination with the turbine cover, so that damage by excessive rotor speed is prevented. The turbine cover contains a steam chamber, nozzle port and controlling valve. A removable plug is placed opposite each nozzle to allow inspection. The construction of the turbine is such that a back pressure up to 15 lb. may be carried, and the exhaust-steam connection is designed so that it may be diverted from the ashpit and piped to a feed-water heater if desired. Each blower is supplied with a steam strainer to prevent scale and other foreign matter from getting into the nozzles and clogging them.

The controlling valves close against the steam pressure, thus allowing them to be packed without shutting down the blower. The nozzles are made of tobin bronze and are so inserted in the casings that they cannot work loose and get into the rotor blading. The rotor is made of phosphor bronze and is of the impulse type. The blades are of cupro nickel and are so inserted in the rotor that they cannot work loose. They are further protected by a band riveted around the entire periphery. The stuffing-boxes are cast to go with turbine casing and cover, and anti-friction metallic packing is used in them. Two bearings are used with the turbine rotor supported between them. They are of the ball-bearing type.



SECTION OF CARLING BLOWER

The fan is made of aluminum, the pitch of the blade being such as to give the maximum amount of air with the least expenditure of power.

Built by the Carling Turbine Blower Company, Worcester, Mass.

PNEUMATIC TRAVELER FOR ELECTRIC CONDUITS

After the conduits for electric wires have been laid, usually underground, there remains the job, by no means a simple one, of stringing the wires through them. One of the most recent devices employed for this purpose is air-operated, the entire rig comprising a hand pump, a pressure tank, flexible air hose, reel for cord and a traveler. The traveler is a small shaft carrying three light disks, each of which forms a more or less perfect piston with the conduit bore for the cylinder. When air pressure is applied the traveler is impelled along the conduit, straight or curved and following the crooks and elbows. A cord is pulled by the traveler and when the other end is reached this cord is used for pulling the wires through.

LUBRICATION OF AIR COMPRESSORS*

Copyright by Compressed Air Society 1919.

Satisfactory lubrication of air compressor cylinders is attained by securing (1) the reduction of friction to a minimum and (2) elimination of carbonization of the oil as far as possible.

For the proper reduction of friction, the oil chosen should have sufficient body to sustain the weight of the moving parts and to form a seal between the piston rings and the cylinder walls, and still not absorb excessive power in the overcoming of the viscosity of the oil itself.

The objections to air cylinder oils which allow more than the very slight amount of carbonization which appears unavoidable, are, of course, well known but may be briefly stated for the purpose of clarifying what follows:

Carbonization of the oil allows the accumulation of deposits of carbon which are sticky in the early stages of their formation but hard and flinty later. Such deposits accumulate on the cylinder valves, in the cylinder passages, in the pipes and eventually in the air receiver.

Sticking or partial closing of the valves and their consequent failure to act properly is probably the chief objection to this action from the standpoint of the efficient operation of the compressor.

The formation of excessive carbon deposits is apt to be due to any one or more of the following causes:

1. The ill-advised use of some oil, such as a steam cylinder oil, which easily decomposes in the heat of the air cylinder.
2. The use of oils of too great a viscosity —commonly referred to as "too heavy oils." These do not atomize readily and, therefore, remain too long upon the hot cylinder walls, etc., thus baking down to sticky carbon deposits.
3. The use of too great quantities of oil, which has the same effect as the use of too heavy an oil as far as the carbonization is concerned.
4. The failure to provide a proper screen over the air intake of the compressor, thus allowing free entrance of dangerous dust (especially coal dust).

The objections to this carbonization aside from the sticking of air valves and choking of the air passages is the menace of fire entailed by carbon deposits. Carbon particles torn loose from them may become incandescent from causes which could not be anticipated by the compressor manufacturer. If such incandescent carbon particles should happen to come in contact with "oil vapor" given off by the lubricating oil, a fire might possibly be started whose menace would be small or large depending upon how much carbon had been allowed to accumulate in the compressor and the piping to the receiver. If these are kept properly cleansed at all times, there should never be a time of any danger.

This oil vapor is given off from a lubricating oil at a certain temperature called its "flash point" just as steam arises from water at a certain point.

HEAT OF AIR COMPRESSION

The selection of an air cylinder lubricant is of course, governed to a considerable extent by a knowledge of cylinder temperature it must withstand. Knowing the air pressures, the corresponding temperatures are ascertained fairly accurately, as shown in Table No. 1.

TABLE NO. 1.—CYLINDER TEMPERATURES AT END OF PISTON STROKE

Air Compressed to lbs. gage	Final Temperature F. Single Stage	Final Temperature F. Two Stage
10	145	
20	207	
30	255	
40	302	
50	339	188
60	375	203
70	405	214
80	432	224
90	459	234
100	485	243
110	507	250
120	529	257
130	550	265
140	570	272
150	589	279
200	672	309
250	749	331

This table gives the final temperature in the cylinder at the end of the compression stroke, for single stage, also for two stage (or compound) compression, when the free air entering the cylinder is 60 degrees F.

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*By H. V. Conrad, Mechanical Engineer, Secretary Compressed Air Society, New York City. Printed from advance sheets.

Variations from these temperatures will occur in actual practice, due to water jacketed air cylinders and radiation, tending to lower the temperature at the higher pressures. But at, say, 50 pounds pressure and lower, the heat is likely to be somewhat greater than given by the table, particularly if the compressor is run at high speed and also if it is not water jacketed.

OIL FLASH POINT AND CYLINDER TEMPERATURES

The natural inference of the reader after noting the temperatures in Table 1, is that he must select an air cylinder oil whose flash point is higher than the maximum temperature apt to be encountered within the air cylinder. As a matter of fact, this is not the case, and it need only be carefully noted that the study of the air cylinder temperatures is useful mainly in testing lubricating oils to determine their resistance against breaking down into carbon, etc. But such temperatures cannot be taken as limits establishing the highest allowable flash point for a lubricant safe to use in the air cylinders.

QUALITIES OF CYLINDER LUBRICATING OILS

For average normal conditions, the oil should be a medium bodied pure mineral oil of the highest quality, not compounded with fixed oils such as animal or vegetable, and should be carefully filtered in the final process of manufacture.

Quite a range of oil composition is permissible for lubricants approved for this work, which are manufactured under the above conditions. Primarily a distinction must be made between those oils having a paraffin base as distinguished from those having an asphaltic base.

From a strictly operating standpoint—so it is claimed by some lubricant manufacturers—there is no distinction between these two classes of lubricants as to their desirability as compressor cylinders oils, provided that both have been properly filtered in the process of manufacture to remove the carbon forming elements. If any carbon should be formed, however, such carbon deposited by the asphaltic base oils is of a light fluffy nature and easily cleaned out, whereas, that deposited by the paraffin base oil is very adhesive, and characterized by the hard, flinty nature.

PARAFFIN BASE LUBRICATING OILS

Merely as a guide to aid the operator in specifying the qualities to be possessed by an air cylinder lubricant recommended for average duty, the following table is presented:

Table No. 2—Physical Tests of Paraffin Base Oils

	Minimum	Average	Maximum
Gravity, Baume	28 to 32 deg.	25 to 30 deg.	25 to 27 deg.
Flash Point, Open Cup	375 to 400 deg. F.	400 to 425 deg. F.	425 to 500 deg. F.
Fire	425 to 450 deg. F.	450 to 475 deg. F.	475 to 575 deg. F.
Viscosity (Saybolt) at 100 deg. F.	120 to 180 sec.	230 to 315 sec.	to 1500 sec.
Color	Yellowish	Reddish	Dark Red to Green
Congealing Point (pour test deg. F.)	20 to 25 deg. F.	30 deg. F.	35 to 45 deg. F.

It is suggested that those oils within the range expressed by the minimum figures be used for light duty of low-pressure and temperatures, while those expressed by maximum figures should be used for high pressures and temperatures.

It is recommended that any paraffin base lubricant intended for use in "all standard air compressors," should meet the physical tests imposed by the average range of figures given in the middle column of the above table. The above wording "standard air compressors" is to be interpreted as including the following types of machines:

a Low pressure up to 100 lb. compressors, which may be either small sized single stage units, or larger sized compound machines.

b High pressure compressors which are constructed with the proper number of stages so that no excessive temperatures are ever reached.

In other words, this lubricant of average test figures is always recommended unless a compressor manufacturer specifies in his printing that a high flash point oil should be used to meet the conditions peculiar to his machine. It is thus obvious that it is never necessary that a lubricant should possess a flash point as high as 500 degrees unless abnormal conditions of high temperature prevail. Such high flash point oils have an unusual tendency to produce carbon deposits.

ASPHALTIC BASE LUBRICATING OILS

This group of oils is considered separately for the reason that the lower limit of gravity stated in the above table, viz., 25 deg. baume, eliminates this entire group from consideration—which is not the intention of this article.

As a guide for the selection of suitable oil, the following table is given:

Table No. 3—Physical Tests of Asphaltic Base Oils

	Minimum	Average	Maximum
Gravity, Baume	20-22 deg. F.	19.8-21 deg. F.	19.5-20.5 deg. F.
Flash Point, Open Cup	305-325 deg. F.	315-335 deg. F.	330-375 deg. F.
Fire	360-380 deg. F.	370-400 deg. F.	385-440 deg. F.
Viscosity (Saybolt) at 100 deg. F.	175-225 sec.	275-325 sec.	475-750 sec.
Color	Pale Yellow	Pale Yellow	Pale Yellow
Congealing Point (pour test)	0 deg. F.	—0 deg. F.	—0 deg. F.

For general all around use, it is conceded that the recommendations given in Tables No. 2 and No. 3 above cover the situation as well as possible, special cases, of course, requiring investigation and special consideration before making recommendations.

PROPER QUANTITY OF LUBRICATING OIL

The quantity of lubricating oil to feed to the air cylinders of compressors, cannot be stated in exact terms, due to the varying viscosity of different oils, the heat of compression and the size of cylinder. It may be stated in general, however, that after the cylinders have acquired smooth and polished surfaces, the quantity should be reduced to the lowest limit to avoid the possibility of the accumulation of carbon and sooty deposits within the system due to excessive use.

The following basis of quantity given in Table No. 4 is recommended, subject to above modifications for these cylinders or equivalent sizes, operating under normal conditions.

It will, of course, be carefully noted and clearly understood that the results in the last column of Table No. 4 are based upon the assumption that under average conditions of temperature and usual range of oil viscosities, a pint of oil will contain an average of about 16,000 drops. It is of course understood that these figures are offered merely as an approximate guide and that every individual must exercise his own judgment in modifying them wherever his own particular set of working conditions is unusual.

A leading authority on compressor engineering contributes the following: "The best way to determine the proper amount of lubrication is to take out the valves from time to time and examine the cylinder. All parts should feel that there is oil thereon. If they feel dry, the lubricators should be adjusted to feed a little more oil, whereas if oil lies in the cylinder and its parts show excessive oil thereon, the quantity fed by the lubricators should be reduced. By thus examining the machine a few times, the proper amount of oil can be determined to suit the characteristics of the particular lubricant used and the conditions under which the machine operates." This is a better way to finally determine the quantity of oil required than by adopting without this experimenting any tabulated number of drops.

PERIODICAL CLEANING OF SYSTEM

The best of lubricating oils will cause the deposit of enough carbon in the compressor system to necessitate the periodical cleaning of it. For the removal of carbon, the machine operator should confine his efforts to the use of soap suds. A good cleaning solution is made of one part soft soap to fifteen parts water. These suds should take the place of oil for a few hours, and be fed into the air cylinders about once a week, either by means of a hand pump or through the regular lubricator at a rate about ten times as rapid as that of the oil. The cleanliness of the air valves when inspected, as they should be periodically, will indicate whether greater or less applications of the soap suds should be made. After using

Table No. 4—Quantity of Air Cylinder Lubricant Required per 10 Hour Day

Diameter of Cylinder Inches	Size of Cylinder Inches	Displacement per Minute Cubic Feet	Piston Speed Feet Per Minute	Sq. Ft. of Cylinder Wall Swept by Piston	Drops Oil per Minute	Drops Oil per 10 Hrs.	Sq. Ft. Oiled per Drop	Number Pints Oil Required per 10 Hrs.
8	8 x 8	120	344	718	1	600	718	.0375
12	12 x 12	320	408	1230	2	1200	613	.0750
18	18 x 18	880	496	2340	4	2400	585	.1500
24	24 x 24	1730	550	3450	6	3600	575	.2250
30	30 x 30	2940	600	4700	8	4800	590	.3000
36	36 x 36	4550	644	6070	10	6000	607	.3750
42	42 x 42	6700	696	7600	12	7200	633	.4500

*Figures of last column are based upon an estimated 16,000 drops per pint of oil at 75 degrees Fahr.

soap suds, open the drain cock of the air receiver, and of the intercooler in the case of compound machines, to draw off any accumulated liquid. Oil should be used again for half an hour before shutting down the machine in order to prevent rusting the cylinder and its fittings. Never use kerosene, gasoline or lighter oils in an air cylinder for any purpose whatever, because of their volatile nature under heated conditions.

CLEANING AIR RECEIVER AND PIPING

It often happens that oil, carbon and other foreign matters are deposited in the air discharge lines and air receiver. A practical method of cleaning is shown on the following page, where a receptacle made of 6-inch pipe is shown set on top of the discharge pipe. The cut shows plainly the construction and what the different parts represent. If a mixture of one pound of Red Seal Lye and eighteen pounds of water is passed into the discharge line at the rate of 60 or 70 drops per minute, while the compressor is running, this will eat out all the accumulation on the surface of the pipe and in the receiver, and if the blow-off valve on receiver is open, all of this foreign matter will be discharged therefrom. This cleaning solution can be used every month or two depending on how much accumulation there may be in the receiver.

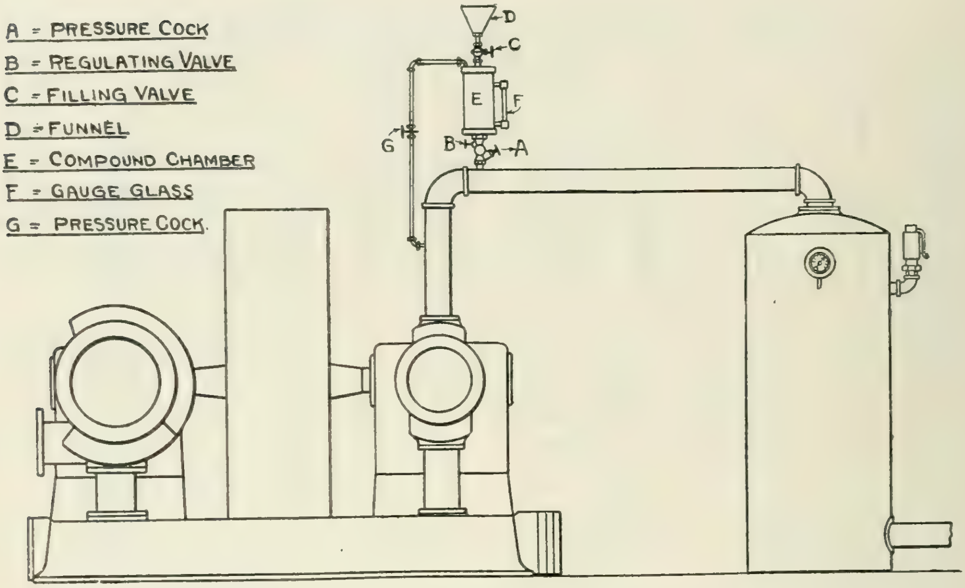
STEAM CYLINDER LUBRICATION

The proper quantity of oil to be fed to steam cylinder is much greater than to air cylinders, due to the constant washing away of the oil by the steam. Approximately four times as much oil will be needed in the steam cylinders as in those for air, subject, of course, to variable local conditions.

Depending on its viscosity, a pint of steam cylinder oil will furnish from 5,000 to 8,000 drops, and taking an average of about 6,500 drops, and four times as much oil as air cylinders of same size, and working at same piston speeds, as given in Table No. 3, the

Table No. 5—Quantity of Oil for Steam Cylinder Lubrication

No. Drops Per Minute	Size of Cylinder Inches	Number Pints Oil Required per 10 Hours.
4	8 x 8	.4
8	12 x 12	.75
16	18 x 18	1.5
24	24 x 24	2.25
32	30 x 30	3.0
40	36 x 36	3.75
48	42 x 42	4.5



COMPOUND:—MIX 1 LB. OF RED SEAL LYE TO 18 LB. OF WATER.

To Use Compound: Close Cock "A" and "G," open Valve "C" and fill Compound through funnel "D," when chamber "E" is filled Close Valve "C," Open Cock "G" and "A" and Regulate Feed by Valve "B;" Use about 70 Drops Per Minute.

DEVICE FOR CLEANING CARBON IN AIR DISCHARGE LINE AND RECEIVER OF AIR COMPRESSORS

recommended amounts to feed the steam cylinders or their equivalents are given in Table No. 5.

These figures are approximate only, and will vary with the steam conditions, the kind of oil used, and its method of introduction into the steam, also with the boiler compound carried by the steam into the cylinder.

ABOUT CHANGING TESTED OILS

When the operator of an air compressor succeeds in obtaining lubricating oils that are giving satisfactory results, he should be very cautions about making a change to other grades, particularly if cheapening the cost is advocated by purchasing and sales agents. But if a change is decided on, the performance of the new lubricants should be most carefully checked up before damage can occur to the rubbing surface of the compressor, and to see that no increased amount of deposit collect on the inside walls of the air receiver.

The most satisfactory way to get the quickest results is to put up the problem of lubrication to the local experts of any reputable lubricating companies, and to be governed by their recommendations, which, however, should be based on the foregoing statement.

AIR INTAKE EXPERIENCE

It was discovered that the intake pipe of an air compressor had parted sufficiently to permit the entire air supply to be taken from a point indoors, below the cylinder. A thermometer placed at the break showed a temperature of 100 deg. F., while the temperature out of doors was 47. Since the loss in efficiency equals about 1 per cent. for each 5 deg. rise in temperature of the air supply, it will be seen that the loss in this case was over 10 per cent.

This compressor carried a constant load, a smaller one taking care of variations, and after repairing the break an appreciable difference could be noticed in the load carried by the smaller machine.—*Power.*

Nearly nine-tenths of the total estimated coal deposits of the United States, or about 3,550,000,000,000 tons, (3 million million+) are stated to lie at a depth not exceeding 3000 ft. below the surface.

DANGERS OF EXPLOSION WITH INFLAMMABLE LIQUIDS AND VAPORS*

BY W. PAYMAN

The danger of explosion due to the ignition of mixtures of inflammable vapors and air is present in many common industrial occupations. It is important that the extent of this danger should be realized so that necessary precautions may be taken when handling or using liquids, such, for example, as benzol and gasoline, which yield inflammable vapors. The exact determination of the factors which decide the liability of a given liquid to give explosive mixtures presents a number of experimental difficulties and perhaps for this reason, has not attracted many investigators; but some information of value to technical chemists may be found scattered in chemical literature.

The nature of the danger to be apprehended during the use of inflammable liquids will depend upon the process or processes being employed. These may be divided roughly into three classes:

(1) Processes in which the liquids are used for crystallisation, precipitation, or as solvent media, or where they are being chemically treated as in sulphonation and nitration.

(2) Processes carried out in drying stoves or rooms, heated externally or by hot air blast, in order to remove the liquids from finished chemical products, with or without the subsequent recovery of the vapors by condensation or washing.

(3) Storage of liquids in tanks, and their transfer therefrom to plant or containers.

Throughout all such operations the danger arising from accidental leakage must also be taken into account.

The two most important criteria for judging the liability of a given liquid to produce dangerous conditions are:

(1) The volatility of the liquid.

(2) The range of explosion of the vapor when mixed with air.

RANGE OF EXPLOSIBILITY

Each inflammable vapor has a definite range of explosibility when mixed with air. Mixtures containing less than a certain percentage of vapor, known as the lower limit of inflammability, will not allow the continued propagation of flame, though a source of heat intensity may cause a logical ignition. If the percentage of vapor be increased, a point, called the upper limit of inflammability, is at last reached when the mixture is again incapable of propagating flame, and no mixture containing a greater percentage of vapor than this upper limit mixture will give more than a local inflammation.

The limits observed experimentally differ slightly with different positions of the point of ignition, as the flame may be helped or retared by convection currents according to whether it has to pass upwards or downwards.

It will be understood that, other things being equal, a vapor which gives with air mixtures having wide limits of inflammability will be more dangerous than one having narrow limits. For example, acetone, with a range of 6.15 per cent. (i. e., between 2.35 per cent. lower and 8.50 per cent. upper limit of inflammability), is more dangerous than benzol, with a range of only 3.3 per cent. (1.4 to 4.7 per cent.). The appended table gives the limits of inflammability of the commoner organic solvents as recorded by different observers.

The vapor pressure of the liquid may be so small at the temperature at which it is used as to be incapable of forming a lower limit mixture with the surrounding air. On the other hand a highly volatile liquid may easily give mixtures which are above the upper limit of inflammability. In the latter event it is important to note that the full range of inflammable mixtures has to be passed through before the percentage of vapor in the air renders the mixture safe; and, when this "safe" mixture has been attained, if the chamber be opened at any time to the outer atmosphere an explosive mixture would soon be formed by the inward diffusion of additional air.

From a knowledge of the vapor pressures of an inflammable liquid at different temperatures, coupled with a knowledge of its "limits," we can predict the working temperature at which the vapor pressure is (1) just sufficient to give a lower limit mixture, and (2) just sufficient to give a higher limit mixture. What may be termed the lower limit temperature of a volatile liquid corresponds in a sense to the "flash point" of an oil, though the latter, as determined by the recognized methods, has no absolute meaning, the results being only relative. It must be remembered, however, that still air does not become saturated with a vapor for a considerable time, and so both the calculated limit temperatures may be lower than those actually required in practice to obtain the limiting compositions. Again, an increase in temperature widens the limits of inflammability, but from analogy with experiments with methane-air mixtures, it is unlikely that this effect will be appreciable over the range of normal working temperatures.

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*Journal of the Society of Chemical Industry.

Two other factors are of importance when considering the inflammability of vapors:

(3) The speed of propagation of the flame in the mixtures with air.

(4) The ease of ignition of the mixtures.

The speed of propagation of flame is important whenever explosive mixtures are liable to be produced in long mains, as, for example, with acetone-air mixtures during the stoving of cordite. It should be noted that the speed of the flame in mixtures of a given vapor with air varies with the vapor content, being at a maximum when the percentage of vapor lies about midway between the limits, and falling rapidly as the limiting compositions are reached.

When considering the prevention of explosions, careful attention must be paid to the possibility of ignition of vapor-air mixtures by mechanical means, due to faulty or normal working of machinery in contact with the vapors. Sparks caused by grinding of ill-fitting parts, or the overheating of bearings due perhaps to similar causes, may be mentioned as possible sources of ignition. Unfortunately very little information is available on this point. Its importance has long been realized by mining engineers, but they have only examined the special tools and machinery used in coal mining to see whether sparks caused in operation would be powerful enough to ignite mixtures of firedamp and air.

The prevention of explosions during storage and transference of inflammable liquids has perhaps received most attention. It will be readily understood that the use of compressed air for moving inflammable liquids from vessel to vessel is attended with great danger. In its place compressed flue gas, nitrogen, carbon dioxide or other "inert" gas may be used with advantage, as the risk of explosion is no longer present if there be insufficient oxygen in the atmosphere in contact with the liquid. In this connection reference may be made to some work by Burgess and Wheeler, which showed that if the oxygen content of the air was reduced below 13.25 per cent. no mixture of methane with such an atmosphere was capable of propagating flame. The same point, and also the effect of added carbon dioxide, has been studied by Clement (U. S. A. Bureau of Mines, Tech. Paper 43, 1913; J. S. C. I., 1913, 32, 1149). The addition of carbon tetrachloride, used largely in fire extinguishers, has been suggested by many authors as a means of rendering liquids non-inflammable, but according to Pfister the quantity required to be thoroughly effective is far greater than the volume of liquid treated.

Methods of Extinguishing burning liquids are discussed by Burrell (U. S. A. Bureau of Mines, Tech. Paper 127, 1915), who also describes the precautions necessary in handling inflammable liquids.

TABLE

Substance.	Power limit.	Corresponding temp.	Upper limit.	Corresponding temp.
	%	°C	%	°C
Benzene	1.4	–5	4.7	5
Toluene	1.4	7	4.7	30
Ethyl Alcohol.	4.0	15	13.6	35
Methyl Alcohol	7.8	13	18.0	26
Ethyl Ether..	1.8	Below –30	5.2	–28
Acetone	2.35	Below 20	8.5	Below 20
Carbon Bisulphide	4.1	Below 20	—	—
Petroleum Benzine	1.1	—	3.8	—
Gasoline	1.5	—	5.3	—
Pentane	1.35	Below 0	4.50	Below 0

In general, the precautions to be taken to prevent explosions will depend upon the individual process, but enough will have been said to indicate the factors to be considered in devising suitable methods. The limits of inflammability are expressed in percentages by volume, and refer to the downward propagation of flame.

ONE OF THE WAR GASES

One of the most troublesome of the war "gases," merely a scientific curiosity before the war, but in recent months a formidable weapon, is chloropicrin, which Stenhouse first prepared in 1848 by the distillation of picric acid with chloride of lime. From its effect in producing nausea and vomiting, it is known as "vomiting gas." It is very stable, being only slightly soluble in water, and is not decomposed by most of the active chemical reagents.

It requires a comparatively high temperature to change it from the usual liquid form into a gas, and it is generally used in gaseous mixtures in artillery shells or bombs. Through its vomiting effect, a slight whiff of it forces the removal of the protective mask. Being so inert chemically masks can absorb it only by the mechanical action of charcoal, yet, though so inert, it is a powerful poison, causes blindness when highly concentrated, is an active lachrymator even when much diluted, and in contact with the skin produces painful and slow-healing burns and deep abscesses. It has been used to some extent in cloud attacks with chlorine. It is effective in delaying the occupation of any ground, as its high boiling point causes it to be long retained in the soil, while it is sufficiently volatile to keep the overlying air stratum thoroughly poisoned. Recently discovered insecticide value promises the material a future in peaceful agriculture.

AUTOMOBILE AIR RESISTANCE

In speaking of air resistance to a moving automobile, an expert first takes up the resistance of the windshield. The air current, he says, strikes squarely on the flat surface and leaves a vacuum behind for a certain distance. Various eddies and back draughts are caused. On a roadster these are extremely unpleasant for the driver, and in a touring car the rear passengers suffer. A sloping windshield helps to deflect the air current in a better way and also decreases the head-on resistance.

The resistance which the car has to overcome is the resistance due to the speed of the car itself plus or minus the speed of the wind, according to whether it is a head or tail wind. For the sake of simplicity a direct wind will be taken so that complicated figures can be avoided by ignoring the side winds. In order to determine the car's resistance to the air, the area of the surfaces that are presented must be determined.

The parts to be considered are the radiator, radiator mudpan, windshield, fenders, front and rear; maximum width of the body, and the headlights.

If tool or battery boxes and spare tires are carried on the side of the car or running board, they must also be taken into account. Not only do they offer additional resistance surfaces to the air, but they tend to break up the air streams, forming various broken and cross-currents.

In order to obtain an accurate idea of the power absorbed by the air resistance, an area of 25 square feet is taken by the expert as the frontal surface affected by wind resistance, as this is a good average for an ordinary car. The formula for getting the wind resistance will be taken where P equals $0.003\ AV^2$. A is the area in square feet, V is the velocity in miles per hour, and P the pressure in pounds. This will give, for the speed of 10 miles per hour, 7.5 pounds; for 20 miles an hour, 30 pounds; for 30 miles per hour, 67.5 pounds.

The next thing to do is to find out how much power is used. This can be determined by the formula:

$$\frac{P \times \text{ft. per min.}}{33000}$$

Working out with the three pressures obtained above the horsepowers required are 2, 8 and 18 respectively. It will be noticed that the horsepower required increases rapidly with the speed, and if a speed of 60 miles an hour be taken the pressure becomes 270 pounds and the horsepower required 72.

The last condition could occur if the car were running at 30 miles per hour against a wind going at 30 miles per hour. This would result in the same wind pressure that would be had by driving at 60 miles per hour without a head wind, but in this latter case the engine would be running at only half the speed and consequently would be developing only half the power.

WHERE TO PUT THE AIR COMPRESSOR ON THE LOCOMOTIVE

The question of mounting on the locomotive boiler the various accessories necessary to the supplementary functions of the locomotive power plant has become particularly acute as it concerns the air compressor. Boiler dimensions have become such as to crowd this important adjunct off the side of the boiler and onto the front end, where certainly, however resourceful the constructor who conceived and executed the idea may be considered to be, the compressor is at a serious disadvantage. Lubricating difficulties are but one of the several phases of the matter that discredit this location. Conditions have arisen lately which have prompted regional directors to caution their mechanical forces against so locating compressors as to obstruct the vision of the fireman or others having occasion to view the track from the fireman's side of the cab. Where to put the compressor seems to be developing into quite a puzzle.

We once ventured to suggest the placing of the compressor in a horizontal position, say underneath the running board or even on the under side of the boiler, in case the design happens to permit. Objection is raised, of course, as though the idea of a horizontal engine, pump or compressor is too radical to permit of any such innovation. Precedent is a great stabilizer, to say the least. If it be essential that the compressor be maintained in an upright position, how would some venturesome designer like to figure out an installation on the forward end of the tender? Are our flexible metallic connections equal to the occasion? A compartment, closed or otherwise, could easily be arranged, permitting ready access for attention while running, and there would be presented the attractive opportunity of providing a water jacket for the air end or possibly a water submerged radiating coil, which would be a quick solution to certain condensation difficulties that some roads now experience. The main air reservoir should find as acceptable a mounting on the tender as it does on the locomotive. Air pump exhaust under some conditions, is an enormous waster of fuel when piped into the exhaust passage or otherwise permitted to escape through the stack. The experiment has been tried of utilizing this steam to pre-heat the water in the tank. With the compressor already mounted on the tender this problem, too, if worthy of solution at all, would be very much simplified.—*Railway Review.*

TRAPSHOOTING AND LEAD MINING

Every trapshooting club is an embryo lead mine, needing only to be worked to return a rich profit, says the *Du Pont Magazine* for February. After three years of shooting over the traps of the Du Pont Club, Wilmington, Del., the grounds were mined and 23 tons of lead was recovered. The grounds at a Columbus, Ohio, gun club were mined several years ago. Twenty-six tons of lead were salvaged, one pound of shot being extracted from 60 lb. of dirt. The Elliott Shooting Park, at Kansas City, Mo., owned by Robert S. Elliott, the pioneer gun-club miner, yielded a quantity of lead worth $850 the first year it was mined. Two systems are used in recovering shot from the ground—the blower and the placer.

The blower system is the simplest and the easiest to install. This method was used on the Du Pont grounds. The surface where the greatest amount of shot fell was scraped, one inch of sod and soil being removed to a shredding machine, where it was chopped up finely. A blower was attached to this machine, which was just strong enough to blow the soil out through a pipe. The shot, being heavier, fell into a trough and ran into sacks. The shot was reasonably clean and readily sold. The entire equipment was inexpensive, consisting of the shredder and the blower and a small gasoline engine to operate them. A force of four men kept the machine constantly supplied with dirt. The placer system is more complicated and more expensive to install, and a large supply of water is needed for its successful operation.

PRACTICAL AIRPLANING

Speaking of Vice President Moody of the Prairie Oil & Gas Co., there is one thing which must be told on him, if for nothing else simply because he so dislikes to see his name in print. He actually scouted the Duke-Knowles pool from Ranger in an airplane. The mud was two feet deep in places, deeper in others, and Mr. Moody and Mr. Sankey, of Skelly & Sankey, wanted to see what was really the status of the Comanche county wells. An aeroplane pilot offered his services. The machine would not carry three, so Mr. Moody made the 21-mile trip first, picking out the well from 5,000 ft. in the air and directing the pilot where to land. The airplane then returned to Ranger, got Mr. Sankey, and brought him down. Both gentlemen returned in the same conveyance.—*Oil Trade Journal.*

In order to stimulate French industries, preparations are being made by France to revive the ancient prestige of her great fair known as the Fair of Lyon, and manufacturers of the Allies and the neutral countries have been invited to display their wares.

There was an average daily delivery of 1026 cars of export material at the port of New York during October.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC
Established 1896

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Those who fail to receive papers promptly will please notify us at once.

Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

Vol. XXIV. March, 1919. No. 3

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AN ADVERTISING OPPORTUNITY

The above title should not fail to attract some attention, for advertising is a recognized business necessity. It is not enough in these days to do honest and competent work in the manufacture of goods, and to produce them in considerable quantities. To keep things going these goods must be sold at a reasonable profit and at a rate commensurate with the speed of production, and this cannot be done unless buyers can be found in sufficient numbers. That they may be found and brought in touch it is necessary that the readiness and fitness and reliability of the goods to be sold shall be generally known, and the one who must sell to make a living is the one to attend to this. The offering of the goods for sale, and the dissemination of the information that they are for sale, with accounts of their specific adaptations, is as much a part of the business of continuous and profitable production as is the accumulation of the raw materials and their successive manipulation and assembling in the shop.

In the olden time business announcements were made by the town crier at the street corners, in the market place, in front of the parish church, the object being to address as many people as possible with the hope that some among them would be interested in some particulars of the information so laboriously disseminated, but we have vastly improved upon those antiquated methods and have added advantages which were unknown before.

All these things can be claimed for the printed periodicals of the day. Several individual publications now number their readers by millions and each entire crowd is more attracted by the announcements in the catchy style in which they are presented than are the casual constituents of the crowds assembled in the streets, with the added advantage that the printed page repeats its appeal every time it greets the eye, while the spoken or shouted word dies with the breath of the speaker.

The literary, the social, the political, the news publications, while they draw the crowds do not sort them out. The specializing technical journal does far better than this, in that the crowd which it assembles is automatically selected and singled out from the general mass. All its readers are interested in and looking for the same things, and they are specialized still in the same way when the advertisements call their attention, and the advertiser, so that he is in line with the specialties represented, must know that his advertisement is not wasted.

Compressed Air Magazine is a specialist of the specialists. While the specialty which it stands for is of unusual reach and importance in the world's activities it has the entire field to itself. It is the only publication in the world devoted to compressed air and "everything pneumatic," and it has an unusually large number of readers for a publication of its class who have joined themselves to it to be in touch with its specialty. If anyone has "anything pneumatic" of commercial value and which he wishes to put before those most interested in that line as a business proposition, where in this wide world shall he place it if not in *Compressed Air Magazine?*

THE GREATER HUDSON TUNNEL

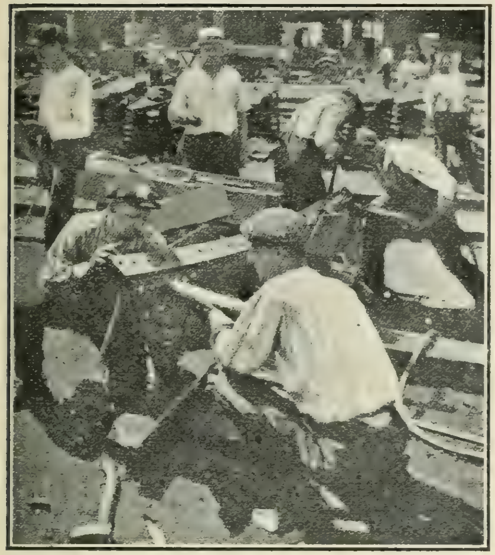
The great engineering works which the growth of the World's Metropolis imperatively demands, each making a new world-record in magnitude of scheme, in the complication of embarrassing conditions involved in the construction, and in the novelty and ingenuity of the devices employed to meet them, follow each other in rapid succession. At the present moment the most imposing undertaking in sight is the building of the great tunnel for vehicular traffic under the Hudson and connecting New York and New Jersey for their mutual benefit.

This is at present spoken of as only a project, but we may be well assured that in a very short time it will be an accomplished fact, and the wonder at once will be as to how the communities benefitted could have so long endured existence without it. Various information concerning the proposed tunnel has already been presented in our pages, showing that everything has been thought out and planned in detail, so that when operations are begun they will be carried forward with a continuous rush. The man who completed the Panama Canal, who is consulting engineer to the Bridge and Tunnel Commission, says that the tunnel can be completed in two years, and he not only knows but has the proved ability to make good his words. The first and determining operation in the case of this tunnel as of every other is the "raising of the wind," and this the financiers and the legislators are already busy at. It is only necessary to have the assurance that twelve millions of dollars will come along as called for, and the public will look upon all the operation of construction as the mere carrying out of the customary routine.

We are specially interested in all tunnel construction, for that is one of the chief and unfailing fields of employment for compressed air. If the tunnel is driven in the solid rock it gives impulse to all the drills and is employed for incidental purposes. In subaqueous tunnels driven in soft material an entirely different application of compressed air is involved. In the big tunnel here spoken of men will have to work under higher pressures then in the tunnels previously driven here, on account of the much larger diameter of the bore which will carry the bottom of it to a considerably greater depth.

When the tunnel is completed and to be put into service another serious air problem arises. This tunnel is to be used by the modern vehicles of the streets and highways, and these whether for pleasure or more numerously for freight light and heavy are now practically all driven by gasoline, the combustion giving off the deadly D O, so that the products of combustion discharged freely into the tunnel must be immediately, continuously and unfailingly removed and replaced by pure air. It is planned to provide blowers and exhausters and systems of ducts which will renew the air content of the entire tunnel every ten minutes, and this arrangement will be by no means too liberal for the purpose when fully active, while if a short stoppage of the circulation should occur a most appalling tragedy might result.

There is thus in this case a special problem which has not before arisen, but which is believed to be fully understood and in competent hands to be taken care of. The valuable and important service which the tunnel can, and doubtless will, render is not to be belittled, and we may well believe that its success will lead to other undertakings as yet but little thought of.



BEGINNING ON THE "FARM"

TRAINING WORKERS FOR THE SHIPYARDS*

By R. V. Rickord

The education and training section of the Emergency Fleet Corporation, known in its embryonic stages as the industrial training department, has been in operation for twelve months. The work of the section consists partly in placing at the disposal of the various shipyards facilities to enable them to do a systematic and thorough job in the training of shipyard mechanics, and partly in conducting other features, such as the distribution of electric welding information and the training of men for the higher marine engineering positions. The policy adopted by the Emergency Fleet Corporation in the matter of trade training has led to the creation of a new trade in the shipyards, namely, that of instructor, and one of the first jobs which presented itself was that of supplying a basis on which to build up this new trade.

When the Emergency Fleet Corporation was quite young, Admiral Bowles foresaw the difficulty connected with the breaking in of new men and the danger lurking in any promiscuous or old-time scheme, such as that in not only taking an unduly long time to make the required mechanics but also in turning them out in "half-baked" condition. While the shipyards were following up the scheme of breaking in men by placing them on the vessels as helpers, the study of how most efficiently to teach men trades had been going on for years by various interested authorities in institutional, municipal and university undertakings. It was from men of this type that Admiral Bowles sought advice and help. The result was the creation of a staff of expert trade teachers, each one of whom was an expert tradesman as well as an expert teacher, and whose job it was to convert an expert shipyard tradesman into a man of his own type, so that the tradesman could break in new men with a thorough working knowledge of the trade in the shortest possible space of time.

A definite scheme of study for prospective instructors was hit upon. Each instructor has had to go through the "dope," as the shipyard men popularly call it. No one has been certified as being qualified for the work of instructor unless he has satisfied the Emergency Fleet Corporation that he can handle a group of green men and instruct them properly.

After a year's efforts a large proportion of shipbuilders all over the country have, with

WORKING UP ALOFT

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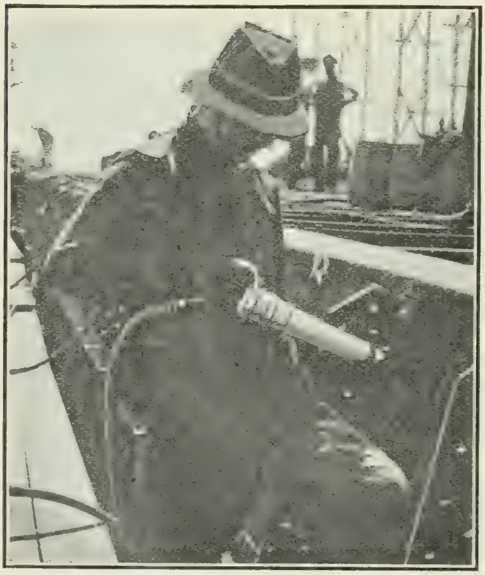
*Abstract from *International Marine Engineering.*

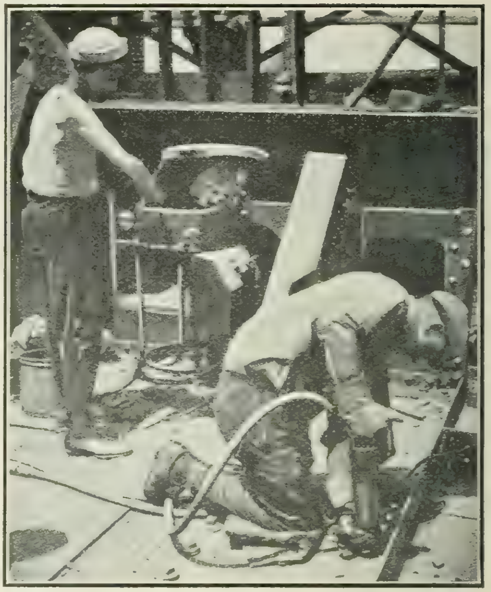
the co-operation of the Emergency Fleet Corporation, installed Training Departments, and in District No. 2, with which this article mostly deals, almost 100 per cent. have recognized the superiority of the new method by installing the training departments recommended by the corporation. The figures showing the number of instructors trained and in training by the Emergency Fleet Corporation for the various steel yards in the district are as follows: Bayles, 9; Downey, 30; Federal, 22; Newburgh, 20; Standard, 10; Staten Island, 9; Submarine, 120.

No difficulty has been experienced in holding the tradesman's interest in the new undertaking. It may, indeed, be said that his efforts along instructional lines are quite extraordinary. He is called upon to make very extensive efforts during his six weeks' training period in learning how best to teach his trade, and this has the effect of so arranging the various details and aspects of the trade in his mind that the yard training department has frequently found itself face to face with the fact that no sooner has he been trained as an instructor than he has immediately been pressed into service as a foreman.

As soon as the embryo instructor begins to analyze his trade for instructional purposes, he sees it in an altogether new light and the new purpose becomes magnified. He picks out a series of representative jobs and gives these to the learner, being sure that the learner has thoroughly learned one representative job in the trade before proceeding to the next. In other words, a smoothness of progression is obtained by starting the learner with the easiest job and proceeding gradually with the harder jobs until the most difficult job that he can be expected to do is given him.



FLUSH RIVETING ON SHELL



FLUSH RIVETING ON A DECK

The riveting jobs shown in the illustrations serve to explain this. Beginning with Fig. 1, the learner is shown doing the easiest kind of snap-head riveting on the "farm;" then the same kind of work on a vessel in an easy position; then doing a somewhat more difficult job—flush-riveting on the deck of a vessel—and after this higher and more difficult positions, until, later, the more exacting flush-riveting work, and finally doing what is probably the most particular work on the ship that can be expected of him, namely, flush-riveting on the shell of the vessel. The instructor is with the learner most of the time and follows him through all these jobs while in training, and in doing this can break in from four to ten new men at a time. All the work of training is done on the vessels or in the shops, so that every effort counts towards the completion of the ship, although the pri-

A FINISHING JOB

mary object of the instructor is not to produce ships but to produce new tradesmen.

The remarkable records accomplished by men who have come from the training departments of the various shipyards only one to three months previously are probably due to the thoroughness with which all of the steps in the trade are taught. The most difficult job a man can do is comprised of the many minor jobs he has done previously, so that having learned the previous jobs thoroughly he finds no difficulty in doing the many small jobs which make up the big one.

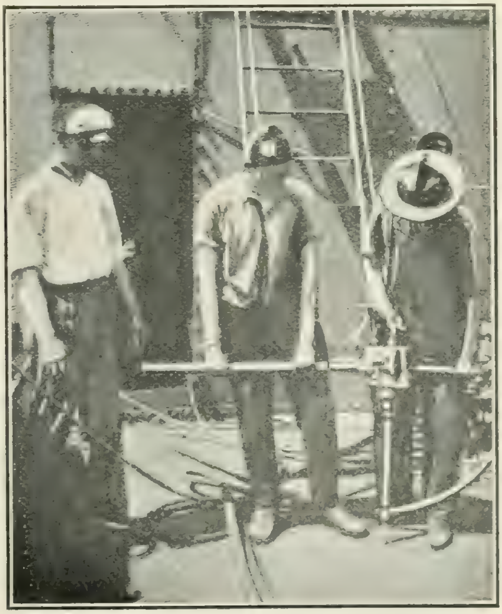
The riveting records of a few men from one yard taken at random will be of interest. The trades given are the former trades of the men, and the records are those per day of ten hours. The yard had a riveting average of about 300 rivets per gang per day, and the men's records, after the men had been transferred from the training department to the production department not longer than three months previously, were as follows:

RECORDS OF WORKMEN

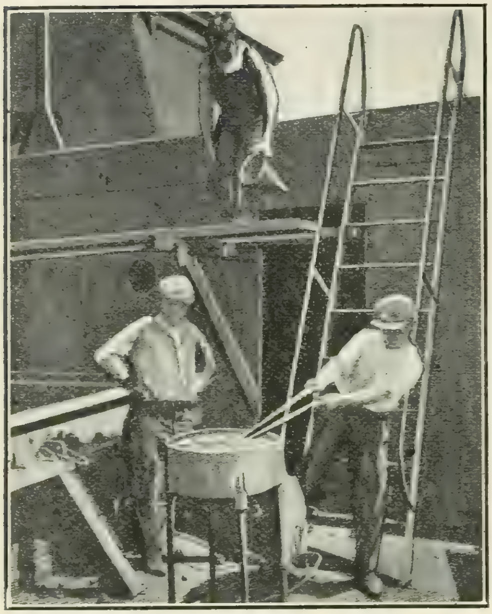
Previous Occupation.	Number of Rivets.	Flush Rivet Sizes.
Auto mechanic	440	7/8
Rock driller	1,808	3/4
Cowpuncher	900	3/4
Laborer	720	3/4
Policeman	640	3/4
Broker	650	3/4
Holder-on	850	3/4
Helper	950	3/4

The reorganization of a training department is such that one individual is responsible for all the training that is done in the yards. The job of this man is really that of "foreman of training," and he is responsible for the making of tradesmen out of "green" material. He works and co-operates with the various fore-

CALKING



REAMING



HEATING AND THAWING RIVETS

men in the yard, but not under them. He obtains from them all the work to be given to the men in training, and is responsible for the correctness and quality of the work. The separation of the training work from the ship work as ordinarily supervised by the foremen is due to the difference in the nature of the job. The men who do the training must have the opportunity to do their work without scampering through it, which is very difficult when done under pressure of the production department.

The ideal arrangement in the establishment of a training department is one in which the department "heads up" under a superintendent or manager who has sufficient sympathy for the movement, or desire for a proper trial, to bring about full co-operation between the training department and the production departments. This type of man obtains for the training department all the work the ships and in the shops that may be necessary to enable the department to fully instruct all the learners it has on hand. Also he will give instructors sufficient time and encouragement to enable them to instruct the learners properly and in accordance with the arrangements laid out, and in which they have been introduced, by the Emergency Fleet Corporation. The placing of the training department under the proper individual superintendent or manager in the yard, in order that the proper co-operation and encouragement is obtained, probably has more to do with the successful working of a training department than any other item.

A TUNNEL VENTILATION PHENOMENON

In *Heating and Ventilating Magazine* attention is called to the peculiar complication of conditions affecting the temperature and the humidity of the air in the Chicago freight tunnel. The great masses of materials of various characteristics through which the tunnel is driven act as a constant reservoir of heat, extracting heat from the tunnel air when the latter is warmer than the tunnel surface. During cold weather the opposite flow of heat takes place, the heat stored in the materials about the tunnel being given back to the air through the millions of square feet of tunnel surface. These conditions balance so accurately that the entire temperature variation throughout the year in the tunnel air is less than 10 deg.

This has had a rather unusual result. In the summer months air is almost always in a saturated condition as the outside air is cooled to the dewpoint. This keeps the tunnel air practically free from dust, partly because the condensation of moisture on the dust particles causes their precipitation to the tunnel invert.

In the summer of 1916 a complaint was received respecting the use of tunnel air in a cold-meat storage room of a certain downtown hotel, the claim being made that such air is unsanitary. Various tests for air purity were made and revealed a remarkable freedom of the air from dust.

SATISFACTORY SAND CAR RECORDS

Sand cars, in which the sand is transported in a steel tank whih can be put under air pressure for the purpose of forcing the sand out through a hose or spout close to the track, have been described in recent issues of *Compressed Air Magazine.* Cars of this type have been in use long enough to demonstrate their entire reliability. For example, the Philadelphia Rapid Transit Company put a couple of cars in service early in 1913, and they have operated with entire satisfaction and have not introduced any particular maintenance difficulties. There is no trouble through the clogging of sand in the discharge pipe if the sand is perfectly dry. The ease with which sand can be forced out through a pipe under air pressure is surprising, but a glance at an hourglass in action will readily convince anyone of the "fluidity" of perfectly dry sand. It is certainly a great convenience to utilize this quality in distributing dry sand to carhouses for redistribution to the cars.

When first put into service the Philadelphia cars had but one source of air which had to provide for braking and also for discharging the sand. This proved to be unsatisfactory in that the cars reached the carhouses without full air pressure on the tank, and some time was lost in the pumping-up process. Now separate compressors are used for the twc functions, with saving of time and lessening of compressor maintenance.

WHERE THE WORKERS WORK

The factory law passed in Japan in 1911 was not promulgated until September 1, 1916. Under this law the employment of boys under 15 years of age and of girls and women for more than 12 hours a day was prohibited, but it was provided that in the textile industries the working hours might be extended up to 14 hours during the two years following the promulgation of the law. In view of the expiration on September 1 last of this limit of two years, the employers concerned had addressed a memorial to the Government early in the year asking for a revision of the law, so that the working hours for small boys and female operatives could be extended up to 14 hours for the next three years, and to 13 hours during the ten years following, but the authorities had rejected the memorial. The factory owners, however, intended to ask again the Government to postpone the curtailment of the working hours.

VACUUM CLEANERS FOR RAILROAD WORK

Vacuum cleaners are used by the Cleveland (Ohio) Railway Co. to clean car interiors prior to painting and varnishing and to remove dirt from motor frames prior to overhauling. A stationary turbine cleaner serves suction headers from which depend drop lines reaching to within 7 ft. of the floor; a minimum length of flexible hosing thence serves any part of the car shop. When it is required to clean motors, the latter are placed over a floor-grating (through which suction is maintained), and covered by a canvas hood. Dust, etc., is loosened by an air-blast and removed by suction; heavy particles are retained by the cleaner and dust is washed into a settling basin under the shop door by a water spray in the eliminator. The equipment is designed to facilitate access to awkward places and its use permits work to be done more thoroughly.

NOTES

Our own navy has now a flying boat which carries 50 passengers with ease. Its wing spread, is 126 ft., length 70 ft. height 25 ft. It is a biplane, with wings 12 ft. from front to rear and is drawn forward by three 12-cylinder Liberty engines driving 4-bladed screws. The fuel carried is 300 gal., which, with armament and military equipment, will serve for 40 to 50 hours' flight.

The Texas Company, South Texas division in order to protect its field men in fighting gas wells, has bought 25 gas masks from the United States Government. The masks were bought at an auction sale at Camp Logan at Houston, and were manufactured for service in France.

In a number of wells in the past in the Gulf Coast section poison gas has been produced and several men have lost their lives in fighting these gas wells. With the protection of gas masks much of the danger will be eliminated.

That white may be twenty-three different colors is one of the surprising things learned recently. The Textile Color Card Association of the United States called for sample shades and found that twenty-three of the largest color users in the country had exactly twenty-three opinions as to the proper shade for white.

The member societies of the Engineering Council are now the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society for Testing Materials and the United Engineering Society.

A well-known motor car was designed by running the weakest parts to destruction and then increasing the factor of safety until the required length of service was obtained. The information that the manufacturer obtained by this method was costly at first, but that car has obtained a reputation for durability that has not been equaled.

The consolidation of the Niagara Falls Power Co., the Cliff Electrical Distributing Co. and the Hydraulic Power Co. of Niagara Falls, N. Y., into a new corporation under the name of the Niagara Falls Power Co. has created the largest electric power company in the world as regards energy output. Approximately 2,000,000,000 kilowatt-hours will be generated yearly in the hydro-electric plants of the company. The company, including the plant of its subsidiary, the Canadian Niagara Power Co., has an installed capacity of 370,000 horsepower and is installing an additional 100,000.

Natural gas carries with it the vapors of gasoline and other hydrocarbons that may be recovered in liquid form by the absorption process. Briefly, this process consists in spraying an absorbing oil downward through a tower and forcing the natural gas upward through the spray. The oil absorbs the gasoline from the gas, which passes out and can be used for fuel. The gasoline is then driven off from the absorbing oil by steam heating and the vapors are condensed, producing liquid gasoline. The absorbing oil, freed of the gasoline, is cleaned and used again as an absorber.

Well-organized shifts and bonus payments were largely responsible for the unusual speed of nearly 200 ft. a month for five months in sinking a 11x21-ft. rock shaft for the Seneca Mining Co., at Mohawk, Mich. A flat rate per day was paid up to the first 100 ft. per month; 2c. per foot per day bonus was paid for all over 100 ft. up to 150 ft.; 3c. per foot per day for all over 150 up to 200 ft. and 4c. per foot per day for all over 200 ft. per month. A total of 994 ft. of shaft was sunk in 129 working days in five months from May to September, or an average of 7.7 ft. per day.

An electric motor of extremely small dimensions has appeared on the market in Germany. The motor is enclosed in a shell of 3 cm. (1.18 in.) diameter and 4 cm. (1.57 in.) long. The shaft is arranged so as to hold tools that are required by dentists and surgeons, but the device should be of great use for other purposes, such as boring small holes in metals and rare stones. The motor can be driven by direct or alternating current, and runs at a maximum speed of 5,000 r.p.m.

In the construction of a 537-ft. by 160-ft. extension to the Vancouver, B. C., pier of the Canadian Pacific Ry., boring and drift-bolting was done by air tools, the air being furnished by a motor-driven air-compressor outfit. Pipe lines were laid from the compressor and connections tapped in with hose leading to air riveters with special sets for drift bolting and to boring machines. The borers proved particularly useful in putting down the 2-in. by 4-in. Australian hardwood flooring, which had to be bored for nailing. For this flooring alone 70,000 holes were required.

A new heat-insulating material is being produced in Sweden which is stated to be very promising. The chief material is a kind of clay, "molera," which is very porous, each grain appearing to be hollow. This fact is no doubt largely responsible for its great heat-insulating properties. After it has been burnt the molera becomes extremely light. Before it is burnt it is mixed with cork. The new insulator is said to be primarily suitable for lagging steam pipes and boilers, but may also have uses for the production of sound-proof chambers, and as a medium to check the transmission of vibration.

The great scarcity of wool in Germany has rendered increasingly difficult the manufacture of air-filters using pockets of woollen material. As air filters are essential in connection with the cooling of electric machines and the operation of compressors and the like, it has been necessary to devise new types of filters not using wool. A firm has developed a filter constructed completely of iron. The abstraction of particles from the air is effected by passing it through iron filtering surfaces that offer a large surface to the current of air, and impose frequent changes in its velocity and direction. The filter differs from other filters without wool in requiring no water or oil, the process being carried out dry.

On the average the original plant substance from which coal was formed contained about 40 per cent. of oxygen and a comparatively low percentage of carbon. As the process of the formation of coal went on the oxygen was gradually decreased and the proportion of the carbon thereby increased. Anthracite coal contains only about 2.5 per cent. of oxygen and a very high percentage of carbon. With the progress of carbonization, the percentage of the volatile matter also decreases and its quality undergoes a change which makes it easier to burn. Thus, although the oxygen content itself may not directly affect the combustion qualities of a coal it may be regarded in a way as an indicator of such qualities.—*Bureau of Mines Bulletin No. 135.*

Mr. G. D. E. Mortimer, a mining engineer, of Point Loma, California, claims to have the highest telephone system in the world, the installation being at an altitude of 15,500 ft. above the sea level. This telephone system is situated at Sonata Bolivia, South America, where the installation of a telephone system for the Inca-oro Mines Company between the various parts of the mine and the town of Yani has just been completed. The total length of the line is 10½ miles, all of the installation being at an altitude of 15,500 ft. Deep snows, snow slides and ice have to be contended with at the mines of the Inca-oro Company, while in the valleys of Bolivia the swollen rivers, terrific heat and the insects of the tropics are equally unpleasant.

The smaller clearances of structures in France, as compared with those in the United States, had contributed, up to some weeks ago, to 127 American soldiers being killed when riding on the tops and sides of cars in France. Three notices were issued to the troops warning them of the danger owing to there being only six inches clearance. One such said: "Three Kinds of Fools. (1) Fools. (2) Damned Fools. (3) Soldiers who ride on tops and sides of cars. A great many American soldiers have already been killed as a result of riding on top of cars. There is only six inches clearance between tops and sides of cars and bridge superstructures. There is only a slight clearance between sides of cars and signal towers. If you expect to see the next block keep yours inside."

The Engineering Societies Employment Bureau, New York City, desires that state and municipal authorities, corporations and individuals who need the services of professional engineers communicate their wants to the Bureau, 33 West Thirty-ninth street. This bureau is maintained by the four national Societies of Civil, Mining, Mechanical and Electrical Engineers. In behalf of engineers who have been serving in the army or in government capacities during the war, it is the desire of the Engineering Societies to get in touch with contemplated engineering projects as early as practicable. By resolutions adopted unanimously (by the 650 members present at its annual meeting) the American Society of Civil Engineers has recorded "its profound conviction that public works should be carried forward to the fullest extent consistent with sound judgment, not only for fundamental economic reasons, but for humanitarian reasons."

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

DECEMBER 3.

1,286.250. AIR-CLEANER. William H. L. Donaldson, St. Paul, Minn.
1,286,302. TRACK-SANDER. John H. Hanlon, Somerville, and William J. Hanlon, Fitchburg, Mass.
1,286,307. ELASTIC WHEEL. Schuyler C. Hatfield, Baltimore, Md.
1,286,319. COTTON-GIN OR LINTING-MACHINE. Wesley A. J. Hodo, Cleburne, Tex.
1,286,359. AIR-GUN. Charles F. Lefever, Plymouth, Mich.
1,286,571. VACUUM-CLEANER. Alva J. Fisher, Evanston, Ill.
1,286,582. AIR AND GAS MIXER. Frank W. Gault, Jr., Okolona, Ky.
1,286,687. FORGING-PRESS. Eugene L. McGary, Chicago, Ill.
1,286,841-2-3. ELECTROPNEUMATIC BRAKE. Walter V. Turner, Wilkinsburg, Pa.

DECEMBER 10.

1,286,939. PNEUMATIC STRAW-STACKER. John V. Carter, Indianapolis, Ind.
1,286,951. AIR-STRAINER. David P. Davies, Racine, Wis.
1,286,992. PNEUMATIC TOOL-DRIVING DEVICE. Andrew A. Gewont, Detroit, Mich.
1,287,007. AIR-BRAKE-EXHAUST. REDUCER. John O. Harrison, Boone, Iowa.
1,287,046. FLUID-DRAWING SIPHON FOR BOTTLES. Fred E. Knapp, San Diego, Cal.
1,287,060. AIR-CIRCULATING DEVICE. Willard M. McEwen, Chicago, Ill.
1,287,142. AUTOMATIC PNEUMATIC CARD-ASSORTING MACHINE. Arthur S. Trew, Portland, Oreg.
1,287,169. VACUUM-PRODUCING SYSTEM. Howard A. Young, Chicago, Ill.
1,287,325. PNEUMATIC STARTER FOR ENGINES. Anton Huwiler, Basel, and Harry Maggi, Zurich, Switzerland.
1,287,367. CENTRIFUGAL COMPRESSOR. Louis C. Loewenstein, Lynn, Mass.
1,287,433. PNEUMATIC COTTON-PICKER. Will H. Radford, Kenedy, Tex.
1,287,557. AIR-BRAKE MECHANISM. John B. Wright and Frans O. Lawson, Greensboro, N. C.

DECEMBER 17.

1,287,630. COMBINED ATMOSPHERIC COOLING AND CONDENSING TOWER. Edwin Burhorn, Hoboken, N. J.
1,287,751. VALVE AND VALVE-GRID SUPPORT FOR AIR-COMPRESSORS. George M. Richards, Philadelphia, Pa.
1,287,780. POP-GUN. Ora A. Stanard, St. Joseph, Mich.
1,287,800. AUTOMATIC FIRE-EXTINGUISHING APPARATUS. Everett L. Thompson, Dover, N. J.
1,288,097. AIR-VALVE AND METHOD OF MAKING SAME. Claud V. Martin, Norwalk, Ohio.
1,288,104. AIR-HEATER. Thomas C. Maxfield, New York, N. Y.
1,288,266. METHOD OF SUPPLYING FUEL TO INTERNAL-COMBUSTION ENGINES, &c. Charles L. Stokes, Los Angeles, Cal.
1,288,312. VACUUM-CLEANER. Joseph Wagner, Cleveland, Ohio.
1,288,370. PRESSURE-GAGE. Ralph W. Zimmerman, Chicago, Ill.
1,288,393. AIR-FILTER. Vito Di Sante, Wichita, Kans.
1,288,420. VACUUM FUEL-FEED DEVICE. Webb Jay, Chicago, Ill.
1,288,435. FLUID-PRESSURE CUSHIONING, DEVICE. George Manierre, Milwaukee, Wis.
1,288,438. METHOD OF AND APPARATUS FOR DRYING AND COOLING GRAIN. Fulton R. Morris, Milwaukee, Wis.; Cassius E. Morris and Mark R. Morris, executors of the will of said Fulton R. Morris, deceased.
1,288,445-6-7. PNEUMATIC SEAT. Henry Seibel, Los Angeles, Cal.

DECEMBER 24.

1,288,496. CLAY-GUN. Edgar E. Brosius, Pittsburgh, Pa.
1,288,705. COMBINED VACUUM-CLEANER AND SWEEPER. John W. Shanahan and Francis C. Mason, Grand Rapids, Mich.
1,288,728. ROTARY BLOWER. Ira H. Spencer, West Hartford, Conn.
1,288,821. AIR SAFETY-VALVE. Thomas William Broderick, Salamanca, N. Y.
1,288,850. OXYGEN-INHALING DEVICE. Harvey E. Easly, Waterloo, Iowa.
1,288,856. RESPIRATOR. Lewis Farr, El Portal, Cal.
1,288,860. COMBINED HYDROAEROPLANE AND SUBMERGIBLE CRAFT. Polomede Ferrari and Enrico Mollioli, East Berlin, Conn.
1,288,879. BLOWPIPE FOR WELDING-MACHINES. John Harris, Lakewood, Ohio.
1,288,887. VAPOR-VACUUM-CONTROLLER VALVE. Harry Hall Hess, Philadelphia, Pa.
1,288,891. SHOCK-ABSORBER. Reuben F. Hoffman, Hamilton, Ohio.
1,288,937. LANDING-GEAR FOR AIRSHIPS. Frederick H. Leinweber, Chicago, Ill.; Curtis H. Leinweber, William H. Leinweber, and Victor H. Leinweber, executors of said Frederick H. Leinweber, deceased.

1. The combination with an airship body, of a plurality of compressed fluid cylinders in said body and extending downwardly with relation thereto; a piston cylinder operating in each of said cylinders; a piston operating in each of said piston cylinders; a piston rod for each of said pistons; a traction wheel on each of said piston rods; and means for supplying said cylinder and piston cylinder with fluid under pressure and exhausting the same, substantially as described.

1,288,965. ROD-BENDING MACHINE. Clyde Alston Nelson, Cristobal, Canal Zone.
1,288,966. TIRE-PUMP. Thomas H. Nielsen, Wyoming, Del.
1,289,039-40. MEANS FOR CONTROLLING PNEUMATIC ANTIVIBRATION DEVICES FOR AUTOMOBILES. George William Bell, Liverpool, England.
1,289,042. BLOW-TORCH. Robert E. Campbell, Berkeley, Cal.

DECEMBER 31.

1,289,082. AIR-CUSHIONING DEVICE. Anson M. Bangs, South Bethlehem, Pa.
1,289,132. PNEUMATIC SHOCK-ABSORBER. Warren S. Eaton, Plainfield, N. J.
1,289,144. PULVERIZED-FUEL BURNER. Harry S. Flanegin, Pottsville, Pa.
1,289,285. VALVE FOR PERCUSSIVE TOOLS. Fred M. Slater, Easton, Pa.
1,289,364. METHOD AND APPARATUS FOR COOLING BEER. Thomas R. Beggs, New York, N. Y.

1. The method whereby beer may be drawn without undue foaming from kegs maintained at atmospheric temperature, which consists in subjecting the beer in the keg to a pressure sufficient to maintain carbonic acid gas in the absorbed state in the beer, cooling the beer after leaving the keg with the stated pressure maintained and reducing the pressure on the beer while still cool and immediately prior to its escape to the atmosphere.

1,289,383. GAS AND AIR MIXER FOR GAS-BURNERS. William C. Buell, Jr., Sewickley, Pa.
1,289,391. CONTROL DEVICE FOR PENUMATICS. Frank Carnahan, South Boston, Mass.
1,289,451. AIR-GAGE. Martin A. Hougen, Minneapolis, Minn.
1,289,543. DIRECT AIR DISPLACEMESNT-PUMP. John Rigling, Philadelphia, Pa.
1,289,546. AIR-HEATER FOR LOCOMOTIVES. Carl Rochelle, Raleigh, N. C.
1,289,672. METHOD OF PRODUCING AND MAINTAINING VACUUMS. William D. Coolidge, Schenectady, N. Y.
1,289,728. PNEUMATIC VEHICLE-SPRING. Herbert H. Giles, Brooklyn, N. Y.
1,289,755. AUTOMATIC WATER-DEPTH INDICATOR. Elbert J. Haynes, Detroit, Mich.
1,289,757. AUTOMATIC TRAIN-CONTROL DEVICE. Isaac W. Hedges, Quincy, Ohio.
1,289,790. VACUUM FEEDING DEVICE. Jacob Jacobsen, San Francisco, Cal.
1,289,795. JACK. Henry Johnson, Detroit, Mich.
1,289,845-6. PNEUMATIC ORE-SEPARATOR. Marion S. MacCarthy, Denver, Colo., and Charles F. MacCarthy, Carthage, N. Mex.
1,289,847. FLUID-PRESSURE BRAKE. George Macloskie, Erie, Pa.
1,289,923. FLUID-PRESSURE-ENGINE INDICATING APPARATUS AND THE LIKE. Arthur Ryder, Hartford, Northwich, England.
1,289,986. VACUUM-PUMP AND CONTROL UNIT FOR PLAYER-PIANO MECHANISMS. Charles E. Wenz, Clifton, N. J.

COMPRESSED AIR MAGAZINE
EVERYTHING PNEUMATIC

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THE BLOW OF THE DRILL BIT SHARP OR DULL.

By Frank Richards

It is sometimes greatly satisfactory to bring theory and practice in touch and to find them reciprocally confirming and strengthening each other. The method of computing the force of impact of a falling weight or of the blow struck by the ram of a steam hammer is essentially simple enough, but its practical application is generally far from satisfactory on account of the indeterminate value of one of the essential factors. We find as the final result in each case that the force of the blow struck may be almost anything, according to the suddenness with which the propelled mass is arrested. It is possible, however, without making the final particular specific, to reach a practical determination which may be most convincing.

A letter, substantially as follows, which has recently come into my hands, would seem to afford an excellent opportunity for a practical application of the principle involved in this line of investigation.

"At a drill test," the writer says, "which is being carried out at a mine near here, and in which I am particularly interested, it has been noised about that while the drill is very effective it is at the same time very hard on the steels. I was, in fact, shown some ten pieces of steel that had been broken in a day's run.

"Now, I am not a steel expert, and in this case I didn't need to be, for at a glance I noted that every piece of steel that had been broken had been used in the test entirely too long; that it had been used in fact after it had lost its cutting power. On some of the pieces the bit end was entirely flattened, no cutting edge at all was left.

"My noticing this was quite an accident on my part, but it worked out all right in the next day's drilling. Just as soon as the cuttings ceased to drop out of the hole the steel was changed and we never broke a single piece of steel. Then on one of the drills we took a dull piece of steel, and in less than two minutes' time the steel broke."

Now, if we apply the theory of the hammer blow to this case we have at once a sufficient explanation. The drill steels did precisely as they ought to have done in the circumstances. The dull steels "went on a strike" against any more striking when in that condition.

The method of computing the force of the blow of a rock drill may perhaps be more simply and clearly illustrated in the case of a reciprocating piston drill, although the results noted, under the same conditions, would be identical in the case of a hammer drill, the latter being now in actual employment more frequent and familiar.

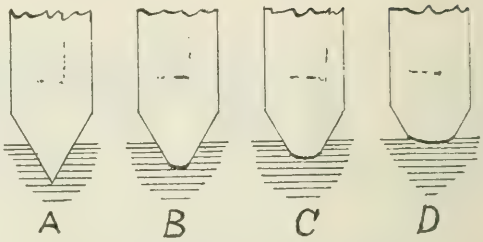
The unit generally assumed in stating or in computing the force of a blow is the foot-pound. Say that we have a rock drill with a piston 3 in. in diameter and a stroke of 6 in. (½ foot), and that in the working stroke of the piston it is driven the entire distance by an effective air pressure of 50 lbs. per sq. in. The area of the piston is almost exactly 7 sq. in., and if the strokes of the piston were 1 ft. the accumulated force at the end of the stroke would be stated as: $7 \times 50 \times 1 =$ 350 foot pounds. Since the assumed stroke of our piston is ½ ft. the resulting force would be only one-half of this, or: 7x50x½=175 foot pounds.

This number of foot pounds of energy might have resulted from various combinations of stroke and pressure, as, for instance, with a stroke of 1 ft. and a pressure of 25 lbs.: 7x25x1=175 foot pounds, or with a stroke of 3 inches, (¼ ft.) and a pressure of 100 lbs.: 7x100x¼=175 foot pounds. It is essential to get this clear in our minds because in bringing the piston to rest, or in the striking of the blow, an opposing force of resistance is required precisely equal to the active force that was employed to produce the motion.

The resistance will of course be required to be greater in proportion as the distance in which the resistance is applied is shorter. Thus 50 lbs. of resistance effective through 6 in. of stroke would be required to overcome the 175 foot pounds of imparted energy, and 6 times this, or 1050 lb., would be required if the stoppage was done in a distance of 1 in. For convenience we may call this last figure 1000 lb.; then 4000 lb. of resistance would be required to stop the movement in ¼ in., and 16000 lb., 8 tons, if the stoppage was done in 1-16 in.

This brings us to what we may assume to be, approximately, rock drill cutting conditions. If the drill bit penetrates the rock, say, 1-16 in. at each blow then this 8 tons is applied, and alternately is stopped entirely, several hundred times a minute, and while our theorizing here requires a constant or mean resistance of 8 tons for the entire 1-16 in. of penetration of the rock, the fact undoubtedly must be that the resistance will be much greater than this at the beginning of the penetration and diminish to nothing at the instant the penetration ceases. If the penetration of the drill bit was only one-half of this, of 1-32 in., that is if the bit was stopped within this distance, then the force of the blow struck by the bit would be double the above or 16 tons.

When we say that the bit strikes the rock with such a force it would be just as correct to say that the rock strikes the bit with this force, for it must be precisely equal in each direction from the point of contact, and the greater the force at any instant with which the bit strikes the rock the greater also must be the reacting force against the body of the bit.



WEAR REDUCES PENETRATION

The rough sketch herewith, representing with perhaps some exaggeration, one of the four wings of a sharp drill bit, and then the same in several stages of wear, may help us to get a clearer understanding of the matter. At A, with bit perfectly sharp, we see that it makes its deepest penetration into the rock. After coming in contact with the rock surface it penetrates the rock a certain distance, during which penetration its force is expended upon the rock in one direction and equally backward into the body of the bit in the other direction.

It is assumed here of course that the drill bit receives at each stroke an equal impulse from the air which drives the drill. We note at B that the bit has been considerably worn or blunted, and that while when it first touches the rock it has the same force behind it which it had at A. it does not penetrate the rock to the same depth, it is stopped within a shorter period of travel, and consequently the force involved in the stoppage must be greater for the shorter period, both upon the rock and back into the drill bit.

No computations could help us to realize the evident fact that the force of the blow upon the rock, and reactively back into the body of the steel, is successively greater when the bit is worn as seen at C and D. At D the penetration of the rock must be extremely minute and the shock upon the drill bit incalculably great. What could be expected of the steel under such conditions, or approaching such conditions, than that it should give up the job and break? The fact of breakage when the bits are too much worn is an endorsement of the efficiency of the drill which applies the power, and demands for the drill appreciation instead of condemnation. A drill which does not break its bits when, on account of dullness, they ought to break, must be defective in some particular.

It will be noted from the preceding that in the action of the drill bit when it wears a paradox occurs. The bit is least effective, has the least penetrative result, blow for blow, when it strikes the rock the hardest and feels the shock the most. It is the sharp bit that does the work; the dull bit is the inefficient victim of mistaken or neglectful practice. Drills must wear, but the limit of permitted wear should be sharply prescribed, and the systematic maintenance of sharp bits should be recognized as the most profitable investment possible in connection with rock cutting operations. Especially is the power drill-sharpener to be commended, not only for its almost incomparably greater efficiency as compared with hand sharpening, but also for its promotion and maintenance of the sharp drill habit of thought and practice.—*Eng. and Min. Journal.*

COMPOUND AIR LIFT FOR MINE WATER

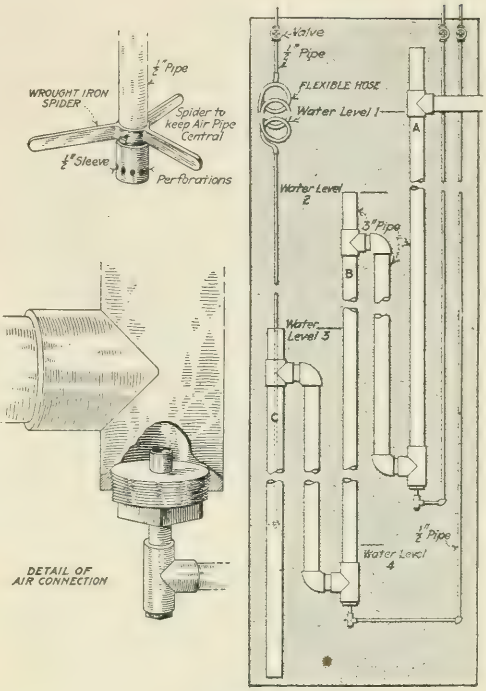
By A. W. Allen

The compound air lift is suitable where objections may be raised against the construction of a sump of sufficient depth to satisfy the efficiency requirements of an ordinary single lift. It is also applicable when the available pressure of air is low. The depth of the various stages can be adjusted in this particular, but it must be remembered that a very low available pressure is likely to cause unnecessary complications in the arrangement by introducing too many units. This necessitates a proportionally large number of pipe fittings, and increases friction. Under such conditions the system is not recommended, although exceptional cases may call for exceptional methods of treatment.

THE FUNDAMENTALS OF A COMPOUND AIR LIFT

A compound air lift is merely two or more simple air lifts arranged in series—the rising main of the first discharging into the sump of the second, and so on. A loss of fall at each stage is inevitable, and this also involves a small loss of power. The system can be arranged to duplicate or triplicate any of the ordinary designs in use; and the customary self-regulating features can be incorporated in each of the various units.

I once had occasion to utilize the compound air-lift principle under somewhat unusual circumstances. An old mine working had to be dewatered to drain an adjoining shaft. The ground was loose on all sides, the timbers were in a rotten and collapsing condition, and ancient-filled stopes would "run," and discharge dèbris at the least provocation. The old working had to be drained as far as possible by a system that made personal attention near the water level unnecessary.



COMPOUND AIR LIFT

A small compressor furnished air at a low pressure; and, even if a pump could have been made to do the work, there would continually have been the danger of interment of both the pump and anyone who happened to be attending to it. A compound air lift was therefore constructed which permitted the gradual lowering of the water to a level in proportion to the depth of successive submergences, and so personal risk was eliminated. Soundings disclosed the fact that timbers had collapsed to such an extent that only a narrow channel remained in one place. This was found sufficient, however, to permit the passage of the lift pipes.

A somewhat diagrammatic drawing of a compound lift of this class is shown in the illustration, but in actual construction it is, of course, possible to bunch the various pipes together, and so insure greater compactness than is indicated. Strainers attached to the foot of the lowest lift, and at other necessary points, are advisable, and should preferably be made of ample dimensions to obviate any throttling of the intake.

The need for the constant shifting and readjustment of the pump, as the water lowers, can be avoided by constructing the apparatus complete and by placing it at the lowest point in the first instance; and then by pumping the water in stages, the various pipes can be assembled, and the added sections bolted or screwed together as the pump is lowered. Permanent air connections are indicated, but can be omitted when it is considered preferable, and flexible connections used instead. The permanent connections were available, in the instance under description, only when the pressure had been reduced by the help of the flexibly connected air pipe.

It will be noticed that the permanent air connections are attached through a plug at the lower arm of a T-piece in each case. This design was purposely adopted to minimize friction, as it was found that the extension of the air pipe into the rising main served no useful purpose and, furthermore, constricted the suction of the pump. By arranging the supply as shown it was found that there was no tendency for the air to escape other than where it was needed, except when an unnecessary volume was being used.

There is one disadvantage in the use of the flexible air connections and a loose pipe system, apart from the fact that the introduction of another pipe in the rising main increases the frictional resistance, and that is due to the fact that the air pipe may rest against the side of the lift pipe. This will result in a partial distribution of the air through the liquid. The objection may be of little account in the case of small lifts, but should be avoided in large ones. The ill-effects may be reduced by bolting a "spider," of three arms, to the outside of the air pipe, near the bottom, which will maintain it in a central position (see cut). The arms must be of such a length that the "spider" forms a *very* loose fit in the inside of the rising main. It is preferably made of wrought iron, and kept from slipping off at the bottom of the pipe by means of a sleeve which may be bored around its lower end, in the manner shown, in order to distribute the air more effectively.

OPERATION OF COMPOUND LIFT WITH FLEXIBLE AIR CONNECTIONS

By reference to the diagram it will be noticed that four water levels are given. It may be assumed that level No. 1 shows the original position of the water. The flexible air connection is then put into the rising main *A* to a depth consistent with available pressure, and gradually lowered therein as the water is reduced in the shaft until level No. 2 is reached. The flexibly connected pipe is then withdrawn from rising main *A* and transferred to *B*. As soon as the second lift is in operation, water will be delivered so that lift *A* can be operated by means of the permanently connected air pipe. As soon as water level No. 3 has been reached, the flexible connection is withdrawn from air lift *B* and transferred to *C*. As soon as this is in operation, the permanent connection to supply air for lift *B* can be used. The final water level will be approximately as shown at No. 4, with the air pipe at the bottom of the lowest lift pipe.

Ratio of submergence to lift will vary in such installations according to local conditions. Economy in small lifts may demand a ratio of from 1½ or 2 to 1 of submergence as compared with lift. In other instances economical work is of secondary consideration, especially where air pressure is low, and a shallow submergence may be adopted.

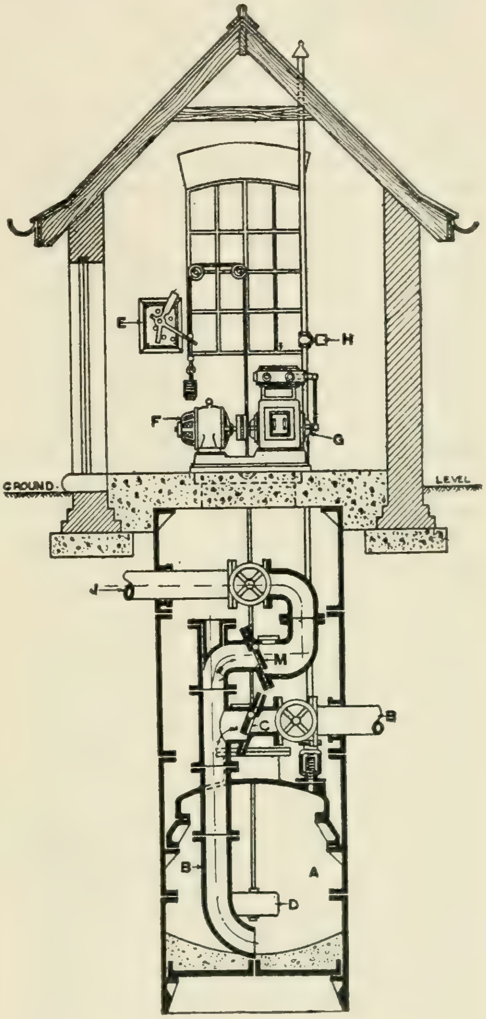
The arrangement shown permits the easy escape of the air when lifting is accomplished. Spasmodic or jerky delivery of water usually indicates faulty conditions as to air volume or submergence ratio, which should be regulated as far as practicable to insure a more or less even stream from the discharge pipe.—*Eng. and Min. Journal.*

NOVEL IDEA FOR A STEAM ENGINE

The following is one of the claims of a recent U. S. patent:

"In a device of the class described, the combination of a cylinder, a piston reciprocally mounted with said cylinder, means for electrically heating said piston, and means for injecting a spray of water onto said piston thus creating steam within said cylinder for driving said piston."

AN AUTOMATIC AIR PRESSURE SEWAGE EJECTOR



AIR PRESSURE SEWAGE EJECTOR

The device brought to the notice of our readers in the abbreviated description and accompanying sketch here reproduced from *Iron and Coal Trades Review,* London, may be regarded as a curiosity rather than as of practical value. The arrangement has an ancient rather than an up-to-date suggestion, the best thing to be said about it being apparently that it will actually work when everything is all right, but the mode of using the compressed air, and the actual wastage of compressed air for filling spaces seriously detract from the practical efficiency.

The device, which is put before the public as a business proposition, is designed to popularize the direct system of pumping water, mud, sand, sludge, silt, gravel, sedimentary deposits, sewage, etc., by compressed air. The apparatus consists of a pneumatic ejector, an electric motor, a float-switch, and an air compressor. The arrangement is shown in the diagram. In operation, the sewage flows by gravity into the ejector body A through the inlet pipe B, passing the flap valve C, and rises in the ejector A. A float D is placed in the ejector and connected to the switch E, and as the sewage rises and falls in the ejector, the float moves up and down; this movement operates the switch E, thus making or breaking the circuit of the motor F driving the air compressor G. For instance, when the sewage attains a pre-determined level in the ejector, the switch contacts are closed by the float, thus starting the motor and compressor, and when the level of the sewage falls to the required degree, the float opens the switch contacts and stops the motor.

On the air pipe connecting the compressor to the ejector, there is a magnetically-operated valve H controlled by the float-switch. When the motor is started this valve is closed to the atmosphere, and when the motor stops it is opened. This action is brought about by means of the float-switch opening and closing the circuit to a solenoid which operate the valve. As soon as the compressor starts working it pumps compressed air on to the surface of the sewage in the ejector. The pressure so applied closes the inlet valve C, and drives the sewage from the ejector A, past the outlet flap valve M into the outlet pipe J, and thence into the rising main, through which it is forced to the desired outfall. The ejector continues to discharge until the float opens the switch contacts. This action stops the motor and opens the exhaust valve H. In this way the compressed air left in the ejector is allowed to exhaust to atmosphere. As the air pressure is being exhausted, the weight of sewage in the rising main closes the outlet flap valve M, when the ejector begins to refill. This cycle of operations is repeated automatically so long as any sewage flows from the sewers.

THE BOILING AND THE CONDENSING OF AMMONIA.

By John E. Starr

It seems to be in many minds that their ammonia or other liquid "flashes' into a gas in some mysterious manner when relieved from high pressure and introduced into the lower pressure existing between the expansion valve and the commencement of the process of liquefaction, as in the compression or obsorption machine. Erroneous theories of operation are then founded on this supposed operation. If the operator keeps in his mind the analogy of his steam boiler the mystery of this action will disappear. If he will simply regard his expansion piping and his "accumulator" system as he regards his steam boiler, and treat it in the same way, all his troubles will be cleared up. If he will further keep in his mind the subject of absolute pressure, unclouded by the pressure of the atmosphere, he will further attain wisdom.

STARTING POINT OF STEAM GAGE

His steam gage through a freak of custom starts at a very indefinite point, generally supposed to be the pressure of the atmosphere at sea level, and to his mind the zero of pressure is about 14.7 lbs above the actual zero. Points below this he calls vacuum, when as a matter of fact there is no such thing, and vacuum should only mean a pressure less than the weight of the atmosphere exerts. The anomaly of the pressure gauge starting as it does with its zero at an indefinite point, is responsible for much confusion in point of view.

All matter commonly exists and is exhibited to the senses in three states,—solid, as ice the solid state of water, or common iron the solid state of iron, or liquid as the liquid state of water or molten state of iron, or as a gas, —as steam, the gas of water, or iron fumes, the gaseous state of iron, all depending on the pressure and temperature under which they exist, and pressure and temperature must never be disassociated.

PASSING FROM LIQUID TO GASEOUS STATE

Water boils or passes from a liquid state to a gaseous state just as surely under a pressure of 1 lb, per square inch and a temperature of 101.76 F. as it does under a pressure of 14.697 lbs, per square inch and a temperature of 212 F. If it has a pressure of 25 lbs. it will have to be kept heated to 240.1 F. to cause it to pass from a liquid to a gas (steam).

In a like manner if liquid ammonia is held under a pressure of 1 lb., it will pass to a gas if heat at 103.7 deg. F. is constantly supplied to it, or if a pressure of 14.76 lbs. is applied it will "boil" or pass to a gas at 27 below zero; while if a pressure of 25 lbs. be maintained it will pass to a gas if a constant temperature of 7.2 below zero F. is supplied, or if it is kept at 30 lbs. (or about 15 gage) it passes to a gas at about zero F.

Now to oblige a liquid to pass into a gaseous condition heat must be applied to the liquid. Take a familiar experiment. Draw off a half glass of anhydrous ammonia; after a moment plunge a thermometer into it, when the bulb of thermometer is covered with the liquid it will register about 27 below zero if the atmosphere happens to have a pressure of 14.76 lbs. If the atmosphere happens to have a pressure of less than 14.76 lbs., say 13.75 lbs. (corresponding to 28 ins. mercury) the thermometer will show between —29 and —30 F.

Add heat to the liquid by immersing the glass in water say at 80 F. but keep the pressure the same. The liquid will boil more violently but the thermometer will not budge because the gas is constantly passing away into the air at the above pressures. Take out the thermometer quickly with a thin film of liquid adhering to the glass and the mercury sinks; but this is another story.

Observe, however, that the frost line is only slightly above the level of the liquid, because you have already put your heat with the liquid and the gas while in its expanded condition it has but little capability for taking up heat and therefore is rapidly warmed up. This at once teaches that little heat is taken up by the gas and that refrigeration is produced, or heat is taken away in a large part, only where it touches or adjoins the liquid and that the gas takes little heat.

It is true that your suction pipe may be frosted clear into your compressor or absorber, but this is only because the gas is solid and takes up some heat or because liquid is present, foaming or projecting mechanically from your "boiler" or expansion piping.

So if you are cooling a liquid (say beer) by direct expansion, and observe that the cooler is "frosted out" don't be sure that it is at full capacity; for the last pipes may be full of a volume of gas and not liquid, and the capacity of gas to take up heat is small and your "tonange per foot" of frosted pipe may be small. Increase your feed of liquid and your tonnage per foot will increase, although to be sure you may run the physical risk of "flooding" your compressor.

Now apply the same line of reasoning that you apply your steam boiler. You would be foolish if you wanted to generate steam, to apply your fire or your heat to the steam space instead of the water. You would be equally foolish to expect to receive heat from the steam line unless steam was constantly supplied to it and was giving out heat in passing back from a gas to a liquid. Nor would you close up the surface from which the steam emerges from the water. You would not fill the boiler chock full of water or take off the drums from your water tubes. You would leave a certain amount of free surface in your boiler or "boiler level" between the water and the steam in order that the bubbles of steam that are formed all through the boiler could have ample room to break through the water surface without dragging water with it and making "wet steam."

So with ammonia, you either provide enough pipe so that the liquid will all be boiled into a gas, even admitting the gas "spits" the liquid a little ahead until it loses it, or you will fill the pipes with liquid and outlet them into an "accumulator" where the gas bubbles have a chance to leave a large surface of liquid without lifting it up and dragging some of it along mechanically, in to the final suction of pipe.

THE DROP OF THE LIQUID PRESSURE

What happens when a liquid under pressure on the high side of the expansion valve passes to a tower pressure on the other side? In the first place the liquid has been cooled to a comparatively high temperature, say 80 F. After it passes the expansion valve it must be cooled first to the comparatively low temperature of its boiling point on the low sides. Say the back pressure is 30 lb. (15-gage); then the boiling point is about zero F. Enough of the liquid must pass from a liquid to a gaseous state to cool the balance from 80 to zero. To do this it takes heat from itself, and enough liquid boils to a gas to reduce the balance to zero F. A pound of liquid passing to a gas will, under the circumstances stated as to temperature and pressure, take up 572-1 B. t. u. But it has to evaporate enough of itself to reduce itself from 80 to zero. This amounts to about 87.3 B. t. u. Hence about 17.5 per cent. of ammonia liquid has to evaporate to lower 1 lb. of it from 80 to zero, leaving 572.1—87.3=484.8 to be supplied by the brim or air to be cooled. This is called the taking out of the "heat of the liquid."

If the air or brim is above zero it will add this heat in time. If it is 10 or 15 above zero it will add heat faster but, as we have seen, it will add it at the same temperature to wit, zero if the pressure of 30 lb. is held constant. The gas resulting from this boiling passes along mixed with the liquid, and finally escapes to the compressor or absorber. As the liquid rolls along it also gradually takes up the 484.8 B. t. u., and the whole mass rolls along until the liquid is all spent or until it reaches the accumulator where the gas separates from the surface of the liquid and goes to the compressor or absorber.

The combined gas and liquid "rolls" along, even "up hill," in the narrow pipe because it is pushed along by the accumulating gas and will continue to roll along, and the liquid will take up heat until it has all passed to a gas and only gas will continue because that gas must go on to fill up the space constantly made vacant by the compressor or absorber. But only where the liquid touches is there any amount of heat taken up.

Towards the end of a direct expansion pipe leading direct to the suction pipe not so much heat per square foot of pipe is taken up because there is not so large a proportion of liquid, it becomes more and more mixed with gas.

An accumulator is placed at the end of the piping system in order to keep the pipes as full of liquid as possible and this accumulator should have "disengaging surface" sufficient to allow the bubbles of gas that come along with the liquid to break through without lifting the liquid and carrying some of it along with it to the compressor or absorber.

If "wet compression" is desired, it is probably better to introduce a definite amount of liquid ammonia by an expansion valve at the compressor, and to boil all of the liquid out in the evaporator, than to rely on the rather haphazard projection from the evaporator.

In a gravity system of evaporation, it is quite possible and theoretically good practice to place a vessel similar to an accumulator at the beginning of the pipe system, and rid the gas generated in cooling the heat of liquid from the cooling coils, by passing it to the gas suction direct.

Regard your expansion system as you would regard your water tube boiler and keep the analogy constantly in mind and you cannot go astray.—*Refrigerating World.*

PAPER MATERIAL MAKES GOOD PIPING

Americans are showing interest in a German war product, "pertinax," a compressed paper material, which appears to have had a double usage: as a substitute for iron, lead and copper pipes; and as a substitute for porcelain or mica for insulators. The pipes are made by impregnating sheets of paper with synthetic resin, and rolling them around a mandrel of the desired dimensions until the proper thickness is secured. Heat and pressure are maintained meanwhile until a hard product is obtained. Formerly natural resins were used, but the introduction of the synthetic variety has raised the temperature of softening to above 180 deg. C. (356 F.)

Difference of opinion seems to exist as to the effects of water upon the material. Though one writer claims that it is insoluble and waterproof, another states: "Their absorption of water makes their use inadvisable for that liquid, but they gave excellent results when used to carry oil, a fact which is explained by the well-known resistance of synthetic resins to oils." There is no record of their being used successfully for water pipes, though they were practical for carrying gas and oil.

Experiments showed that pertinax pipes could bear interior pressure three to four times as great as that of lead pipes, while the weight is less than a ninth that of lead. A series of tests made at the Royal Institute for Testing Materials showed that they are not fitted for construction uses, since, while their resistance to tension is sufficient, their resistance to compression and their elasticity are both too feeble. The tensile strength is 14,250 lb. per sq. in. The stuff may be worked similarly to wood, being turned, stamped, sawed out and bored.

A HYGIENIC SAND BLAST ROOM

The outline sketch shows a complete sand blast room with appurtenances and connections built by the Pangborn Corporation, Hagerstown, Md.

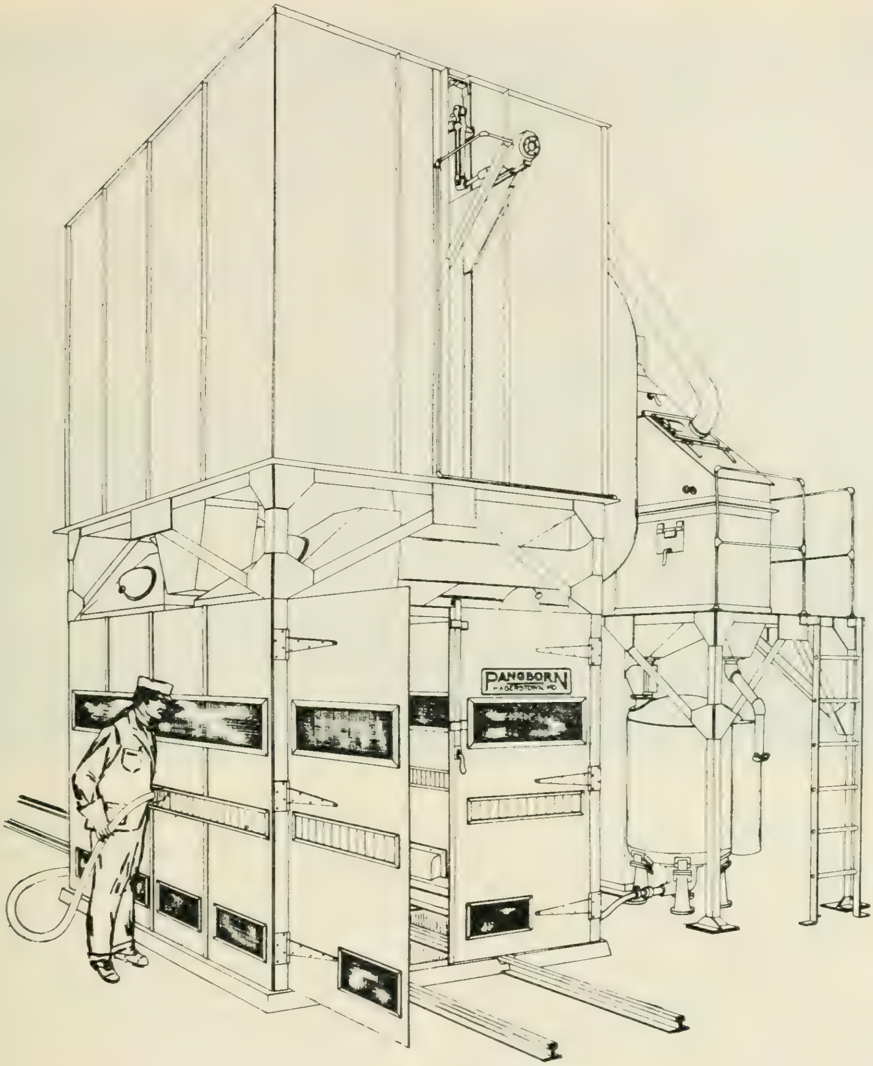
This type of installation is designed for the handling of large work and to provide means of operation that render unnecessary the presence of the operator in the room where the sand blast operation takes place.

The room as here shown is constructed of 3-16 in. steel plate supported by reinforced steel structure. Around the four sides of the room at convenient height is a nozzle slot closed by multiple, sectional, flexible curtains, through which the nozzle is inserted and allowed freedom of movement in all directions. Above the nozzle slot at eye height is a sight screen, fully protected by specially woven heavy wire cloth, which prevents escape of flying abrasive and permits unobstructed view of the interior of the room and the work.

The sand blast machine, which is of the direct high pressure type is located outside the room with hose of sufficient length to permit the operator to reach every portion of the structure. The room is equipped with a grated floor through which the spent abrasive, core sand, refuse, etc., pass to the conveyor trough where a sectional type screw conveyor delivers it to an elevator boot, the entire material being raised to a combined mechanical screen and exhaust separator where the fine dust, core sand and refuse material are separated and passed to a refuse bin piped for discharge to a convenient point. The clean sharp abrasive for re-use is delivered to a storage bin connected to the sand blast machine by a filling valve, for automatically refilling the machine.

Electric light fixtures with white porcelain enameled reflectors and fitted with discoloid fronts to protect the lamps from flying abrasive, are placed as required for ample illumination throughout the entire room.

The dust generated by the blasting operation is drawn off through a ceiling hood and passed to a dust arrester. This arrester, of the cloth screen type, is mounted above the room and supported by the structural frame. The dust laden air enters at one side, the air passing through a multiplicity of cloth screens which retain the dust, delivering it to hoppers



HYGIENIC SAND BLAST ROOM

which can be piped for discharge as convenient.

Air inlet screens to permit free ingress of ample fresh air are placed around the base of the room. A heavy, close woven-wire screen cloth on the outside entrance prevents entrance of foreign material, while on the inside a hooded baffle prevents escape of flying abrasive and dust, and without retarding entrance of the air. The room can be equipped with industrial track to pass through swinging doors at either end for routing of the material as desired.

This type of room is particularly advantageous in the handling of large heavily cored work and is made to conform in size and shape as nearly as is practicable to the work, so that ventilation requirements may be kept at a minimum. For the cleaning of long pieces such as lathe beds, etc., these are usually handled one-half within the room, the entrance being protected by flexible curtains through which half of the casting projects, the piece being turned to clean the other end. In this way pieces up to 20 and 30 ft. long may be handled in a room but half the length

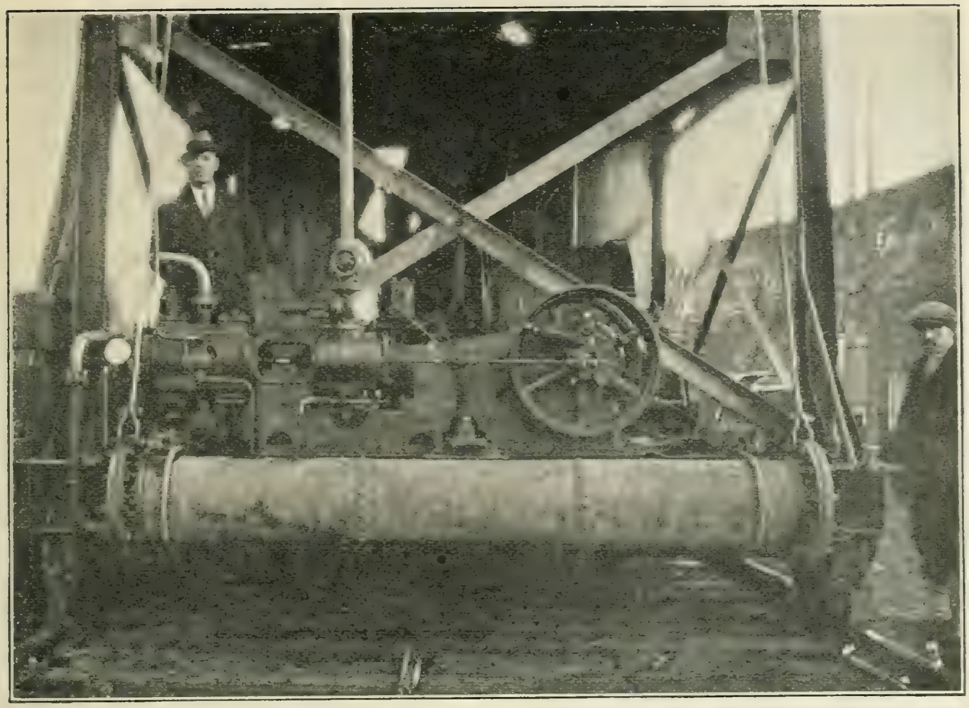
SPECIAL TRANSPORTER IN GYPSUM QUARRY

AMERICAN GAS MASKS

German poison gas has been found harmless against gas masks worn by the United States troops in France. Field tests show that these masks afford twenty times more protection than German masks, and there is not a single case on record of an American soldier falling victim to a German gas attack when wearing the masks manufactured in the United States. This fact has been so thoroughly established by repeated experiences that military authorities place the blame for gas poisoning on the carelessness of the victim. Many American Army officers believe that in most cases the men who get gassed should be courtmartialed, not decorated. Every American soldier who goes to France is a gas-mask expert. He has been trained to adjust his "land life preserver" with almost incredible speed. The mask is put on with five motions of the arm and hands. Although a gas mask is a very uncomfortable article to wear the first few times, the soldier soon becomes accustomed to this handicap on the natural way of breathing. It fits over the head like a baseball catcher's mask. A nose clip closes the nostrils and insures breathing through the mouth by a tube connected with a canister filled with chemicals. The exhaled breath leaves through a flutter valve near the chin. Air cannot reach the mouth except by passing through the chemicals in the canister, and exhaustive experiments show that these chemicals never fail to extract the poison.—*American Machinist.*

INDUSTRIAL GAS MASKS

The Bureau of Mines announces that it is making a preliminary investigation of gas masks with a view to establishing a list of approved devices for use in the mining and allied industries. After the preliminary investigation the Bureau will issue a schedule of tests which apparatus must meet in order to gain the approval of the Bureau of Mines. These investigations will be conducted at the Bureau's Pittsburgh station by men who have had intimate connection with the development of mine rescue apparatus and gas masks used in warfare.



COMPRESSOR AND RECEIVER ON TRANSPORTER

A SPECIAL QUARRY TRANSPORTER

The two photos here reproduced tell most of the story of a transporter doing good service in the gypsun quarry of Cafferata & Co., Newark-on-Trent, England. The material is loosened and broken up by jackhamers and then is delivered by a steam shovel into a tracting car which is hauled up the long inclined track and dumped upon the pile a portion of which is seen at the left of Fig. 1. The width of the track upon which the transporter stands gives it the required stability with the traveling car at either end.

On the platform of the transporter are a steam boiler and engine for driving the drum which carries the wire rope for hauling the car back and forth. There is also an Ingersoll-Rand compressor, F R-1, which supplies air at a constant pressure of 80 lb. for operating the jackhamers. The air receiver, it will be noticed, is somewhat unusual, being made of 16 in. wrought pipe suspended immediately in front of everything by a rod at each end, with also a clamping loop at each end holding it horizontally.

CHANGING THE TONE OF A SHOVEL

The English manufacturer has often been accused of failing to adapt his products to the needs of foreign markets, but a striking instance of the reverse is mentioned by Mr. Cecil Walton in the *Journal* of the West of Scotland Iron and Steel Institute. In South Africa the Kaffirs used an implement which is known as a Kaffir pick, which really was a flat spade in the shape of a heart. This was used as an axe, as a pick, and as a spade. A sample of it was brought home to this country and reproduced here. Mr. Walton said that he would have defied any man to detect the difference between the English and the native article. But still they could not sell it, so a representative went out from home and right up country. He found there was one thing that the Kaffir used the pick for of which they knew nothing. That was, he took it out of its haft and used it as a cattle call, and they found they had not quite the right note. Having discovered this, they reproduced the Kaffir pick with the right note and established an enormous trade in it.

SAMPLING OF DUST IN MINE AIR*.

In the course of such mining operations as drilling and blasting, a large amount of fine dust is produced, and, being infinitely small in size and of little weight, it remains in suspension in the air of the mine for a long time. Examinations of the lungs of miners who have died from miners' phthisis show that the lung tissue has been converted, to greater or less degree, into a mass of siliceous tissue, in which is imbedded a large number of small, sharp, angular pieces of quartz. This condition is due to the constant breathing of the fine particles of dust present in the mine air.

Nature has provided means of rejecting a certain amount of the dust present in the air breathed, but when the quantity is so large and the particles are so small as in mine air, the natural filter becomes choked and allows the dust to enter the lungs.

PRECAUTIONS TO REDUCE DUST IN MINE AIR

The use of water to allay the dust produced in mining operations reduces the danger to a great extent. Directing a spray on the hole in all drilling operations with machines; insisting on all hammer boys using water, even in collaring a hole, and on the use of a wet swab when the hole has been started; sprays in drives, water blasts at blasting time, and other precautions effectively carried out have so reduced the amount of dust in suspension in the air that the danger of contracting silicosis, or miners' phthisis, is being materially lessened.

PERIODICAL SAMPLING DETERMINES EFFECTIVENESS OF PRECAUTIONS

To assure precautions to keep down the dust and to prevent carelessness in regard to the use of dust-allaying appliances, a system of sampling the mine air for dust has been adopted, and periodical tests are made throughout each mine to see that dust is being allayed to the lowest possible amount. The method consists of passing a known quantity of air through a known weight of pure sugar. The sugar, dampened with the moisture present in the mine air, becomes sticky and catches all of the dust in the air passed through it. The sugar is then dissolved in hot water and the residue of dust filtered off and weighed. Because of the minute size of the dust particles and also of their light weight, special precautions against contamination must be observed in all dust-sampling operations, and it is necessary to exercise great care in taking the samples so that the results may be dependable.

An air suction pump consisting of a metal cylinder 22 in. high and of 3-in. diameter, double acting and fitted with ball valves, is the principal part of the sampling apparatus and is shown in an accompanying cut. The pump requires constant attention, and the piston rod and ball valves should be oiled daily before being taken underground. A small quantity of medium oil should be poured into the inlet tube, and several strokes of the pump taken to introduce the oil into the cylinder. The gasket and nut at the top of the piston should be screwed down tight, and the pump tested by closing the inlet pipe and trying to pull out the piston. If the pump leaks, the piston will come up easily, which it should not do.

The pump should be calibrated from time to time, and at least once a month against the standard air meter in the Chamber of Mines laboratory. This will give the number of strokes required to aspirate the required quantity of air.

The sugar containers for collecting the dust are simple in construction, consisting of a glass tube (5 in.x1¼ in.) fitted at the top with a solid rubber cork and at the bottom with a rubber cork through which passes a piece of glass tubing. On top of the latter cork is placed a small pad of cotton wool, which prevents the sugar from being sucked down the tube into the pump. Forty grains of coffee crystal sugar, ground to pass a 10-mesh and remain on a 20-mesh sieve, are placed in the tube and the solid rubber cork is fitted into the top of the tube.

A 6 ft. length of ½ in. rubber tubing is used as the connection between the sugar tube and the pump. One end of the rubber tube is attached to the inlet pipe in the pump and the other to the ½ in. glass tube which projects from the bottom of the sugar tube. It is necessary that the rubber connection be examined frequently to see that there are no leaks, and care must be taken that it is prop-

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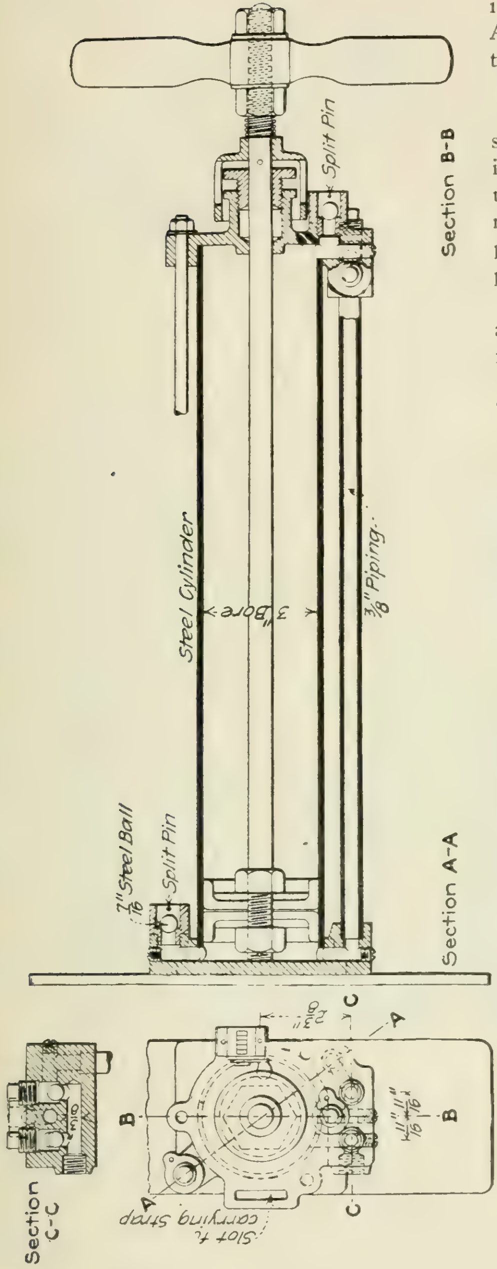
*From report of J. Boyd, chief sampler, Transvaal Chamber of Mines, Johannesburg.



PUMP FOR DUST SAMPLING

erly fastened to the pump and to the sugar tube.

The sugar tubes should be carried in a wooden box, lined with felt, of a size convenient for underground tests. A useful box is one 19 in. long., 11 in. wide and 3 in. deep. A thermometer should be carried in the box, together with a small note book.

MANNER OF PROCURING THE DUST SAMPLE

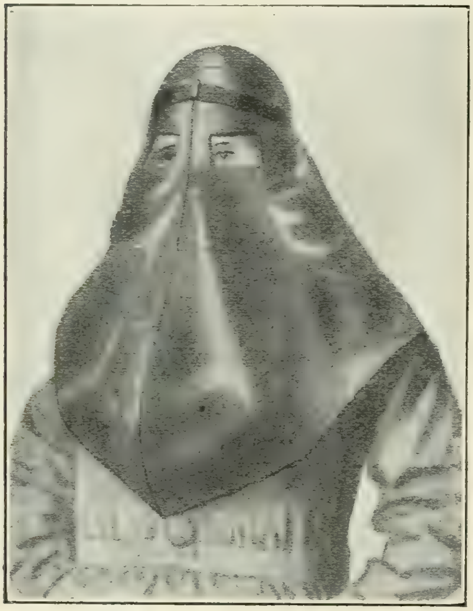
Having tested the pump, see that a full stroke is taken each time that the pumping is done. This must be done at a slow, regular rate—10 strokes per minute being the maximum—as the successful working of the pump depends on a slow, regular rate of pumping.

The quantity of air to be tested should be a fraction of 1 cu. m., and it usually requires from 100 to 120 strokes of the pump to secure 1-3 cu. m. and from 150 to 200 for ½ cu. m. The time consumed should never be less than 10 minutes, and usually should be 15 minutes.

One end of the rubber tube is then attached to the inlet of the pump and the other end to the ½ in. glass tube of one of the sugar tubes. The sugar tube should be held about 5 ft. from the ground and the rubber cork removed from the top of the tube. As a precautionary measure, care should be taken to see that the sugar tube is not under wet hanging, so that drops of dirty water or material fall into it. It is well to remember the small quantity of dust that is to be collected and weighed, and that the greatest care must be exercised by the sampler. When the sample is complete, the rubber cork is replaced in the tube, which should be cleaned with a dry, clean rag.

The dust sample should be as far as possible, representative of the air being breathed by the man at work, and it has been found by experiment that the best place to take a sample in a drive, a raise or a winze is about 10 ft. from the face. In a stope, the sample should be taken nearer the machine.

The object of dust sampling is to ascertain the amounts of dust present in the air being breathed by the men working in the mine, to trace that dust to its point of production, and, if the amount is excessive, to adopt measures to abate it. After taking the sample, notes on the following should be secured: Number of the tube; place where sample was taken; time of sampling; temperature; type of machine; nature of work in progress; character of holes being drilled; water appliances and how used; number of men and boys at face of the working; appearance of hanging; appearance of air (hazy, foggy or otherwise), and the sampler's impression of place and work, i. e. if care is being taken and water used. The sampler should make careful observations of the dust conditions of the mine and note the number of sprays and water blasts erected and in use; see that connections to water blasts and to water jets are installed and in order, and be prepared to give an opinion of the dust conditions of the mine and of the dust allaying appliances.



EMERGENCY AIR BAG

An emergency hood for protection from gas or other poisonous fumes is being marketed by the Safety First Supply Co., Hartje office building, Pittsburgh. This device, known as the Diamond emergency hood, is put on in six seconds, and one filling of air is sufficient for 15 minutes' wear. At the expiration of this time the wearer comes out into the open air, slips off the hood, scoops it full of air and cleanses it, after which he again fills it with air and is ready for another 15 minutes of service. The hoods are airtight and fireproof. Large, clear 6-ply mica windows, vulcanized in the hood, offer unimpaired front and side vision. The hood can be rolled so that it will slip into a coat pocket.

COMPRESSED AIR IN THE MANUFACTURE OF CONCRETE PIPE

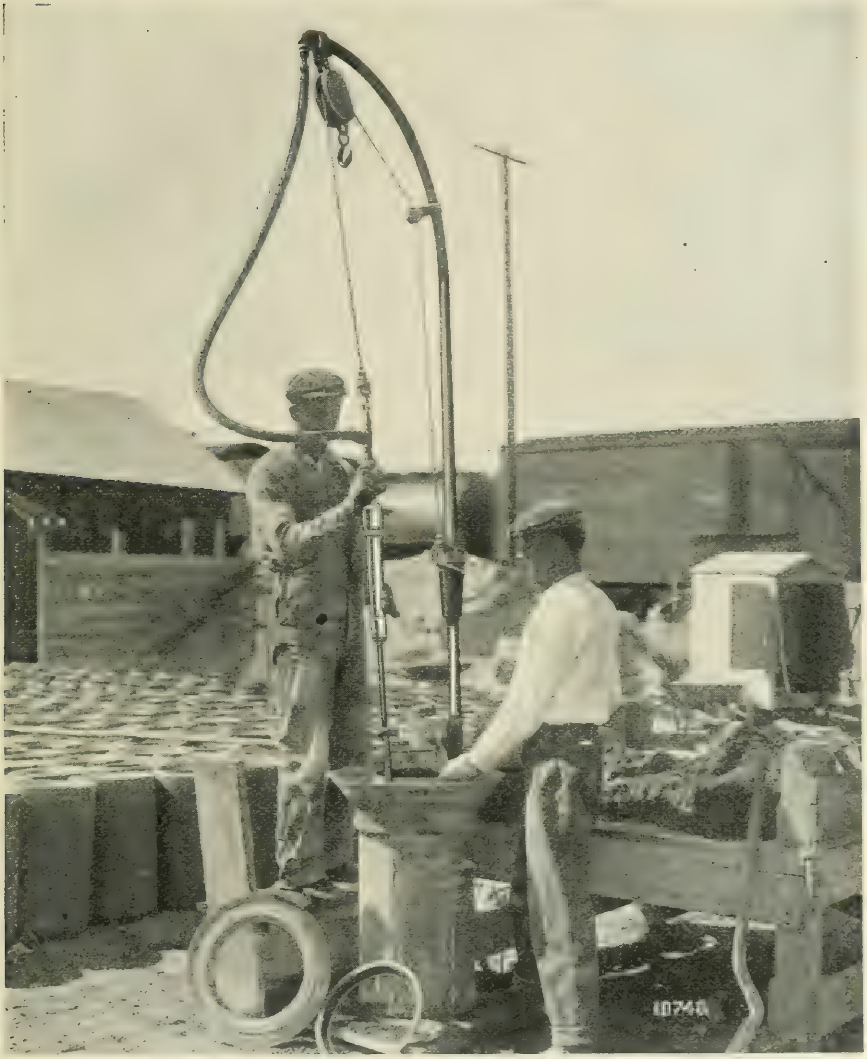
By D. W. C. Grove

The hand manufacture of concrete (cement) pipe has been the generally accepted method in vogue among pipe manufacturers for many years. This is in part explained perhaps by the fact that they have followed the lines of least resistance, seemingly secure in the belief that to manufacture a really "better" product was unnecessary because of the fact that their product as it was had a ready market.

With the demand which has arisen for pipe built to withstand higher pressures and to exhibit greater uniformity and density, the manufacture of concrete pipe has undergone a radical change, and, aided by pneumatic machinery, there is produced in many plants, not only the materially "better" grade of pipe demanded but a product which is of larger value commercially. In addition to these gratifying results of pneumatic pipe construction there is the important fact of increased production with the same force, with its resultant of reduced costs per unit produced.

Several concrete pipe manufacturers in California have installed air compressors and Crown pneumatic rammers, and the results have far exceeded expectations. Moreover, not only does the installation of an air compressor provide for pneumatic and mechanically perfect tamping of the concrete mixture but it offers a source of cheap power for the operation of various pneumatic tools, such as portable grinders, chipping hammers, etc., and further modernization of the process such as pneumatic conveyance of the mixture.

While there are some small points of difference in the details of manufacturing concrete pipe with compressed air, the essentials are very much the same and a description of one plant will suffice to give a thorough understanding of the subject in general. Upon advice of the manufacturer of pneumatic machinery who thoroughly investigated conditions before making a recommendation, a manufacturer of cement pipe installed a 7x6 in. air compressor, electrically driven, a compact self-contained unit. This furnished power for two Crown Pneumatic Rammers to provide for present needs, while a spare rammer was held in reserve.



RAMMING CONCRETE PIPE

These pneumatic rammers were counterweighted as shown in the illustration, rope and pulley blocks giving added flexibility of operation, so that the guiding of the tool around the form is the only physical requisite necessary to tamping. The tamping tool is formed from a straight steel rod, tapered at one end to fit the piston of the rammer. The opposite or ramming end of the tool is formed to a foot whose overall dimensions conform to the diameter of the pipe undergoing construction. The mold consists of two forms, for the inside and the outside of the pipe. The inner form is collapsible to permit ready removal, while the outer form expands for like purposes. These forms are set up on a sheet iron plate over a ring which centers both.

When the form is set up and ready for use it is filled with rather dry cement mixture and is tamped while being filled. The complete operation requires about 40 seconds on a ten inch pipe. When the form has been completely filled and tamped with the pneumatic rammer, the funnel is removed and the cement is packed at the top with a flat ring slipped over the inside form. Another ring is set on the top forming the joint for the top end. The inside form is then removed and the mold is carried to a suitable drying place where the outside form is removed and the pipe is left to set, standing on the lower ring. The upper ring is allowed to remain to preserve curvature. This entire operation is performed in approximately two minutes, employing two men. If four men and two molds were used each rammer could make a pipe per minute.

The Pneumatic Rammer is a very simple and sturdy machine which is readily handled by unskilled labor. All moving parts are protected against dust and dirt, the throttle is handy to the operator and gives positive control of the tamping tool and the entire outfit is self contained.

Average time for completing length of concrete pipe:

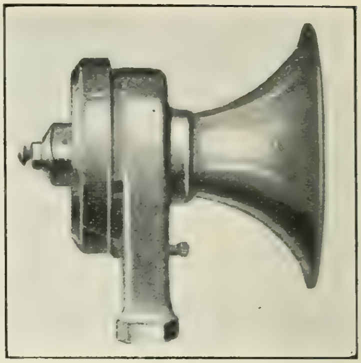
12" x 1⅝" x 24"	41 seconds
14" x 1⅝" x 24"	46 seconds

It is interesting to note that in the manufacture of concrete pipe 12" x 1⅝" x 24", the operator, using a pneumatic rammer, encircles the form from 15 to 22 times during the molding of each length of pipe and delivers an average of 575 hammer blows every 45 seconds with the rammer. Comparing this speed with the speed of hand tamping, averaging about one blow per second, it is found that pneumatic tamping is over twelve times as fast as hand tamping. When it is considered that the operator of a pneumatic rammer can average his maximum speed during an entire working day without becoming tired and "slowing down," the evidence of increased production is plainly in sight.

The major advantages of pneumatic ramming in the manufacture of concrete pipe, as opposed to hand ramming under the older methods, can be summed up as follows:

1st—More pipe can be made in a specified time. 2nd—Pneumatic ramming results is a superior grade of pipe having greater density and uniformity. 3rd—There is no physical strain incidental to pneumatic ramming, and a cheaper grade of unskilled labor can be employed.

The world-old fact that the impossible cannot be accomplished by the use of hot air, however liberal the supply.—*N. Y. Herald.*



THE VIBROPHONE

This is an air vibrating whistle made by the Newman Manufacturing Company, Pittsburgh, Pa. It can be used wherever there is a supply of compressed air, making a loud, penetrating and distinctive sound always distinguishable from that of any ordinary steam or air whistle, even at a distance. It has no complicated parts to repair or keep in order, or to be lost, and can be easily screwed on to a ¾ in. pipe. The three parts of it are a brass cap, the megaphone and a phosphor-bronze diaphragm. The vibrophone is designed to operate with a pressure of from 25 pounds to 80 pounds of air. A good sound is produced with the minimum pressure, but the greatest penetrating and carrying power is obtained at from 60 to 80 pounds. It is claimed that the volume of air required is less than for whistles of the more familiar type.

COMPRESSED AIR IN A SHELL PLANT*

By R. E. C. Martin and S. B. King

The uses of compressed air are well demonstrated at the plant of Winslow Brothers Company, Chicago, which before the war manufactured ornamental iron and bronzes for architectural purposes. This business falling off, by reason of inactivity in the building line, the plant was converted to the manufacture of munitions, and a new equipment specially adapted to the manufacture of 155mm (6.1 in.) shells was installed.

The shell blanks are delivered to the factory in the form of pressed or drawn steel forgings, cylindrical in shape, with one end closed, weighing about 180 lb. each. In many of the

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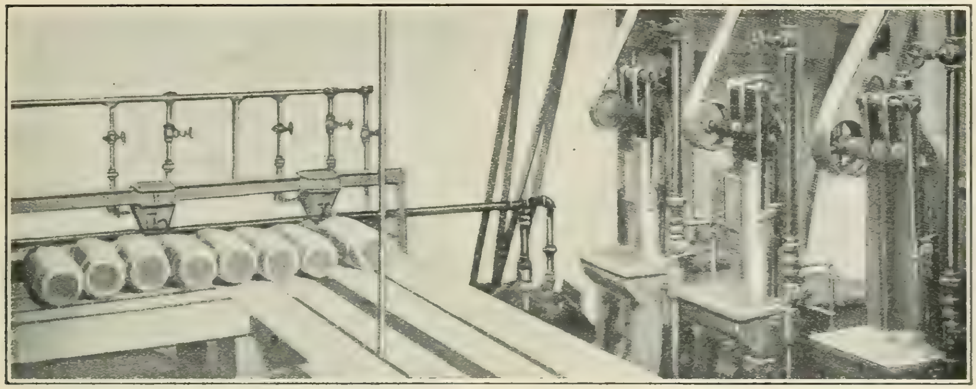
*From *Mine and Quarry.*



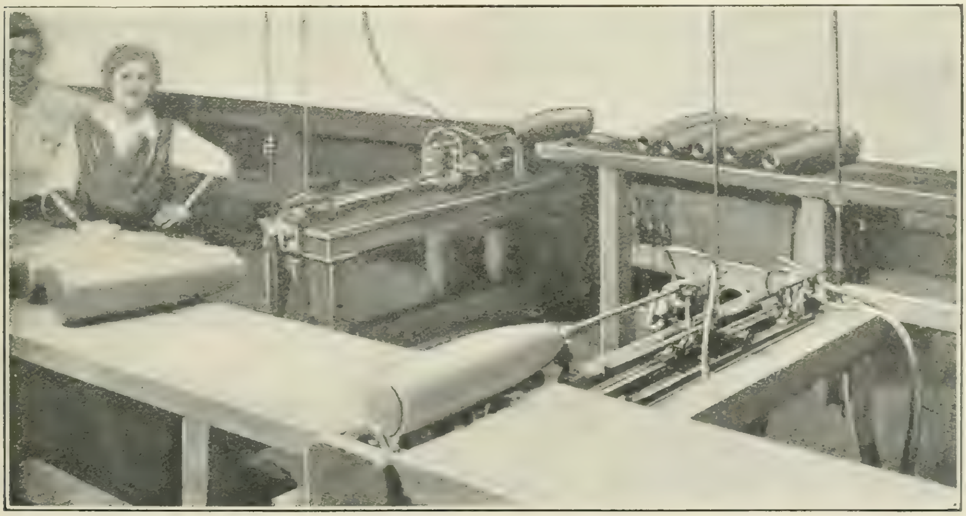
SAND BLASTING SHELLS

47 operations performed at this plant compressed air forms a time and labor saving agent of the first importance. Air chucks of improved standard pattern are used on practically all the lathes and boring tools for holding the work and releasing it quickly.

These processes include cutting off the end of the skull blank, rough and finish turning, turning the nose and base to exact dimensions, turning the bourrelet, turning the waved groove near the base on which the capper ring which engages the rifling is forced, turning the rifling grooves on the ring itself and boring out the interior of the shells. The use of air chucks, by means of which the work can be tightened or released instantly, has been one of the most important contributions to the cutting down of the time required in the turning process, and also saves considerable labor.

After the shells have been turned to exact dimensions, both inside and out, they are taken to the sand blasting machines, where the roughness left by the tool is carefully removed. Fig. 1 shows a battery of rotating sand blasting machines, with the shells in position. Two cuts or stages of sand blasting are performed. A preliminary blast is first given them, and they are then finished on the machines shown which put the final finish on the interior of the shell.

Compressed air is used also in the machine



VARNISHING SHELLS INSIDE

employed for washing out the interior of the shell. The shell is placed nose down over a nozzle through which steam, caustic soda solution or air can be discharged as desired to wash, dry and cool the interior. This process removes excess varnish, dirt, etc.

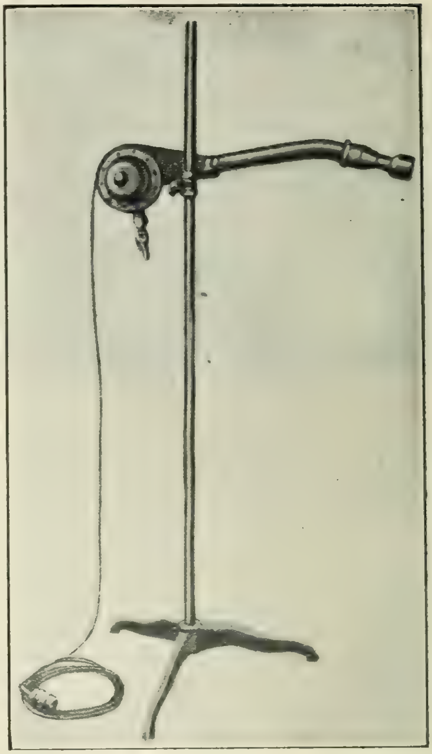
In Fig. 2 may be seen the varnishing machines at work. It would be a difficult and tedious job to varnish the interior of these shells, with the degree of care and evenness required, by hand. The type of machine shown consists of a sprayer mounted on a hollow spindle which is connected by hose lines with the air supply and with an overhead reservoir for varnish. It does the work rapidly and well. The spindle is moved forward into the shell and the varnish sprayed onto the interior surface as the spindle is withdrawn. The shell is revolved in the meantime, so that an even coating of varnish is applied.

This is one of the last processes through which the shell goes before it reaches the final inspection by the Government officials at the plant.

Compressed air is also used in the form of a jet to cool the primary windings of the shell-band-heating transformers, or ring heaters, which are employed for heating the copper bands, or rings, which are forced by powerful hydraulic presses into the machined groove near the base of the shell. On these bands the ridges for engaging the rifling are subsequently machined. The jet of compressed air is applied through the base of the winding chamber.

An interesting feature of the air compressing installation is that instead of being grouped centrally in a power house it is distributed about the plant at convenient points where the air is most used. As the four compressors employed are two-stage machines with efficient intercoolers the temperature of the air when it finally enters each high pressure cylinder is very little above that at which it enters the low pressure or intake cylinder.

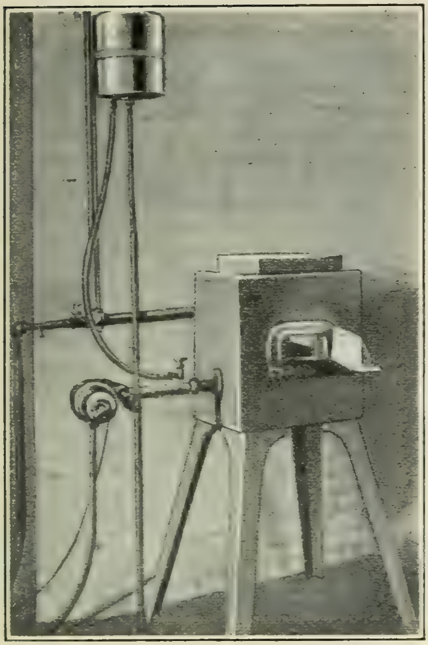
Receivers of ample capacity are installed close to the compressors. A 700 ft. aftercooler is also provided for the compressor that furnishes air to the sand blasting machines and varnishing sprays. It is effective in providing dry air, which is essential in sandblasting the interior of the shells.



A HIGH TEMPERATURE BLOW TORCH

This torch is made by the North American Manufacturing Company, Cleveland, and as here shown is adapted to a variety of uses. A simple method is employed for producing the pressure and mixture necessary for high temperature combustion of gas or oil fuel. The device consists in effect of a mixing chamber, motor-fan, delivery pipe, and nozzle. Flexible tubing supplies gas from the line, while a lamp socket connection and drop cord deliver current to the machine. A small electric motor-fan draws air into the mixing chamber where it meets and is mixed with the gas. This mixture then is impelled by the fan through a delivery tube to a specially designed nozzle, where it burns at high temperature. The action in the apparatus is similar in effect to that secured in a bunsen burner, with the added velocity and volume of the mixture contributing a higher temperature to the flame.

A floor stand with a vertical post is provided and the torch may be adjusted to any



FURNACE WITH BLOW TORCH

height. The flame developed by the ordinary burner is several feet in length. A supplementary burner, which may be readily attached, gives a flame about 10 inches long where a localized heating effect is desired.

The gas consumption for this torch is said to vary from 18 to 52 cubic feet per hour with artificial gas. A special burner is provided in case it is desirable to use oil for fuel.

The company recently has developed a larger burner on the same general plan as that described. In this unit a motor fan unit is installed so that its impelling blades deliver directly to a supply line running to the torch. At one side of the fan is a central intake from the gas supply line. Opposite to this is the air intake with a diaphragm opening which may be rotated to control the air supply. A special nozzle is used which has an air regulating valve. This latter is for use in event that the supply of air is delivered from one fan to several nozzles, and it is desired to cut down the supply to any one of them. The blower delivers the mixture of gas and air at about 4.7 ounces pressure, but will operate up to one pound pressure. The gas consumption for this unit, it is said, is 550 cubic feet per hour for natural and 800 cubic feet per hour for artificial gas.

Special burners also are manufactured by this company for use with fuel oil. These are in effect atomizers, supplied with air through the fan unit described previously. In this case air is secured at both sides of the fan and forced through to the nozzle. A small positive action rotary pump driven by a motor receiving power from a lamp socket is supplied to deliver the oil fuel under pressure. This pump is rated at 90 gallons per hour. Each of the oil burners described is designed to consume only 3½ gallons of oil per hour.

COMPRESSED GAS FOR MOTOR VEHICLES IN ENGLAND

The only instance in which compressed gas has been regularly used for some years is that of the Neath Corporation tramways, where the receivers are charged up to a pressure of 200 lb. per sq. in., the cost of compression working out to less than 5 per cent. of the total cost of the gas. At Neath, however, there are facilities for obtaining a fresh charge at reasonable and convenient intervals, so that conditions are scarcely to be compared with those in the metropolitan area. In fact, the London General Company find that conditions in general call for the employment of a very much greater degress of compression than has hitherto been found practicable, with the result that their new containers are to be charged to a maximum pressure of 1,000 lb. per sq. in.

The extremely high pressure involved has required the employment of storage cylinders of special construction. Two of these cylinders are used on each omnibus, being placed one on either side beneath the interior seats. The cylinders have each a compressed gas capacity of rather more than 600 cu. ft., so that a run of 20 miles may be made before recharging becomes necessary. The main body of the cylinders, composed of copper, is 10 in. in internal diameter and 9 ft. in length, while the two ends are formed of circular steel plates so fitted as to make a perfectly gas-tight joint on a radius formed on the ends of the copper tube. The whole is strengthened by six steel stays, which pass through the cylinder from end-plate to end-plate, and finally the exterior periphery of the cylinder is wound with three layers of steel tape in 1-16 in. thickness. It is pointed out that this principle of construction will avoid bulging or sectional fracture, while any tendency towards distortion will be in the form of elongation, which is provided against by the longitudinal stays.

The two cylinders are connected in parallel, by a ⅜ in. pipe, to a main reducing valve which is a combination of a cut-out and diaphragm arrangement, and by means of this valve the gas pressure is reduced to some 2 lb. per sq. in. The gas then passes through a secondary valve into a flexible fabric container which operates as an expansion chamber, and practically as a governor. For instance, when the fabric chamber is fully extended it actuates a valve spindle which cuts off the supply, the surplus gas passing by way of a by-pass into the chamber of the reducing valve, which again cuts off the high pressure supply. Conversely, once the gas is emitted from the engine control valve the fabric chamber contracts and the series of operations is reversed so that a further supply is received from the containers. The system is particularly commendable in that it is entirely self-acting and demands practically no attention from the driver. The advances which have been made in the construction of valves for the purpose is shown by the fact that stuffing-boxes having proved unreliable have been replaced by seals formed by a combination of grease and rubber rings inserted beneath the valve body.

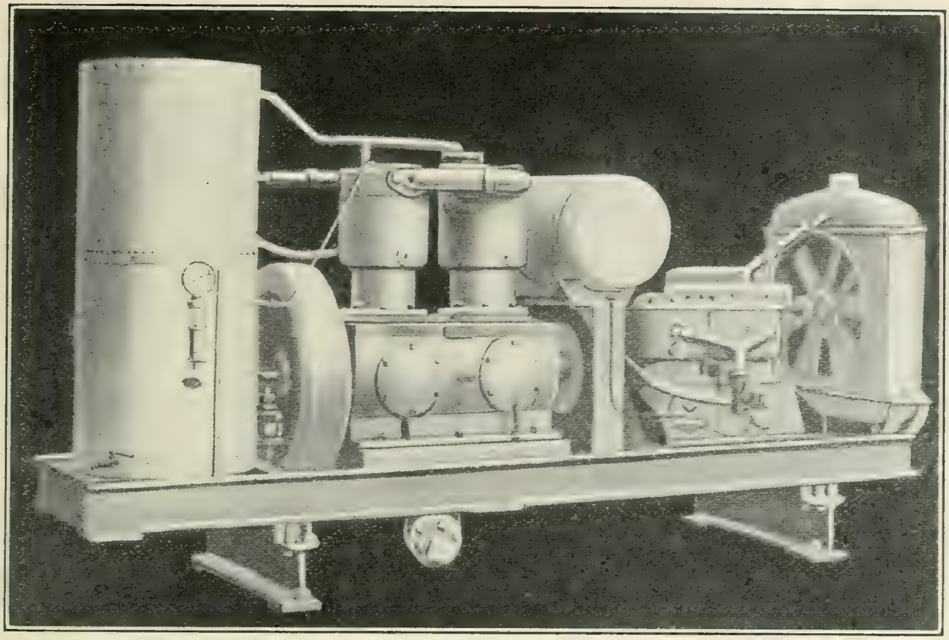
For recharging, the London General Company will have in operation at their Cricklewood depot a Reavell compressor having a capacity of 15,000 cu. ft. an hour. This compressor will be coupled to a series of storage cylinders of 30,000 cu. ft. capacity, controlled by a hydraulic accumulator, which is introduced for the purpose of ensuring the maintenance of a constant pressure. The whole installation is to be so arranged that a number of omnibuses may be recharged simultaneously from a common pipe line. In the earlier days of gas traction it will be remembered that the opinion prevailed that the engine designed primarily for petrol (gasoline) consumption was capable of yielding with gas only 85 per cent. of the maximum power obtainable with petrol; but it was then pointed out that were the engines designed for a higher compression the power ratio would compare very closely with that given for petrol. This appears to have been corroborated by experiments, for in a series of trials with the new arrangement it has been shown that the power obtained from the engine is equivalent to that obtained with petrol. The running figures which have been obtained are decidedly instructive in that they bear out previous estimates as regards the gas equivalent of petrol (in this instance the average relations being 280 cu. ft. of gas per gallon of spirit), while the average saving in cost, which is very considerable at low speeds, amounts to rather more than 50 per cent. as compared with petrol. The normal consumption of gas has been shown to be 35 cu. ft. per mile on a straight 10-mile journey.

As in the case of most gas vehicles the London General omnibuses are fitted with petrol supply arrangements for use in case of emergency. For this reason the ordinary petrol carburetor is retained. The change from one fuel to another is easily effected by engaging whichever throttle lever it is required to operate. A particularly novel feature of the new omnibuses is the use of gas instead of electricity for lighting. For this purpose a special reducing valve and governor are carried, the lighting supply being distributed at a pressure of 10-lb. per sq. in. Incandescent mantles are employed, and each is enclosed in a small fused silica protector. The merit of the system, however, lies in the fact that, whereas the usual electric generator installation weighs something approaching 3 cwt., the necessary apparatus for gas lighting runs to little more than 22 lb.

OUR GAS SERVICE

Some interesting facts in regard to our war activities are now beginning to appear. For instance, when the armistice was signed Germany was producing 30 tons of poison gas a day, England about the same, and France even less, while the U. S. A. during September and October were producing 200 T. a day and were just getting well started. One plant was to cover 200 acres, and in a small part of it 100 T. a day of chlorine was produced and 112 T. of caustic as a by-product.

And this work was as dangerous as trench warfare. During August the casualties in the mustard gas plant were 3.5 per cent. of the working force a day. Many were injured for life; not a few gave their lives in the service.



AN ENGLISH GASOLINE DRIVEN PORTABLE AIR COMPRESSOR

The machine here shown has been recently put on the market by Lacy-Hulbert & Company, Limited. It was designed to be employed in connection with temporary local work of various kinds, as bridge building, ship repairing, water raising, etc.

The arrangement comprises a gasoline engine with its fuel tank and radiator, an air compressor with its separate cooling water tank, and an air receiver. The component parts are all mounted on a stout frame built up of 6 in. and 3 in. rolled steel joists, so that the complete unit can be picked up and put down wherever it may be required. The weight is about two tons, and the overall dimensions 11 ft. 9 in. long by 3 ft. 2 in. wide by 5 ft. 11 in. high, so that it can conveniently be carried on an ordinary 3-ton truck and, if necessary, run at work without being unloaded.

The compressor is one of Messrs. Hulbert's two-cylinder, water-cooled machines. It works at a speed of some 320 revolutons per minute, and has a capacity of 130 cubic feet of free air per minute delivered at a working pressure of 100 lb. per square inch. The two cylinders are cooled by means of water jacketc., which extend over the covers besides embracing the barrels. The valves are placed in the cylinder covers and are all removable independently. An unloading valve is fitted on the inlet branch. It is operated by the pressure in the receiver in such a manner that the load on the engine is relieved when the demand for compressed air falls off. The crank shaft of the compressor is fitted with a heavy fly-wheel at one end, and a toothed gear wheel at the other. The latter engages with a spur pinion keyed on an extension of the engine crank shaft, which is supported by an outboard bearing.

The engine generally employed is either of the Dorman, Aster, Parsons or Austin type, and is of some 32 brake horse-power when running at 1000 revolutions per minute. It is, of course, fitted with a governor. The radiator is of large capacity, and has a fan driven from the main crank shaft. The gasoline tank has a capacity of about 20 gallons, which is stated to be sufficient to keep the engine running for at least six hours. The air receiver has welded joints. It is fitted with a pressure gauge, safety valve, &c., and has a 2 in. delivery connection. Above the receiver, but separated from it to prevent the transference of heat, there is a riveted steel water tank for cooling the air compressor cylinders on the thermo-syphon principle.—*The Engineer.*

AERONAUTICS

The United States Navy Department has successfully carried out the experiment of launching an airplane from a dirigible balloon. The airplane was attached by a 100-ft. cable to the dirigible; both rose to about 3,000 ft. and then the airplane was released; after diving about 1,000 ft. it obtained sufficient speed to continue its usual flight.

The approximate air-line distance between New York and London is 3,000 miles. Suppose an airplane capable of 200 miles per hour were to have a 100-mile following wind, it could make the distance in ten hours. As there is a difference of five hours in time between the two cities, the occupants would have to leave New York at three A. M. to arrive in time for a six o'clock dinner in London. But if they could find an east wind of 100 miles per hour they could leave London at one P. M. and arrive in New York at six, and have time to dress for New York's seven o'clock dinner.

In a note dealing with the possibilities of the commercial airships, issued recently by the British Air Ministry, it is predicted that future airships will have a capacity of 10,000,000 cu. ft.,a propelling apparatus of 6,000 hp., and a maximum speed of 85 miles per hour. These ships would be 1000 ft. in length, 150 ft. in overall height, possess a range of 20,000 miles, and could stay aloft for three weeks without requiring refilling. The crew would consist of three officers and 26 men, and the freight capacity would be 200 tons. The cost of a 10,000,000-cu. ft. airship is estimated at between $1,000,0000 and $1,500,000. From *Aviation*, February 1, 1919.

Further details are now available regarding the record flight of a U. S. Navy seaplane with 50 passengers at Rockaway on November 27. The machine was an N. C. 1 of the flying boat type, the wings having a span of 126 ft., fitted with three low-compression Liberty engines, each of 385 hp. The normal speed of the machine is 80 miles per hour, but with 50 passengers this was reduced to 72 miles per hour. According to the report of the Aero Club of America, the machine left the water within 1000 ft. at a speed of 45 knots, and rose to a height of 35 ft. It is stated that the machine can climb 2000 ft. in ten minutes.

Plans for a large dirigible of the Zeppelin type, 400 feet long, semi-rigid, with a lifting capacity of 25,000 pounds and a cruising radius of 2,000 miles, have been drawn up by the Goodyear Tire & Rubber Company. The airship is designed to make a speed of sixty miles an hour and to carry twenty-four people.

Plans to carry important documents to ships at sea, such as clearance papers and late mail, have been completed by the Kerr Steamship Company, it was announced to-day. Under the new plans, freight steamers will be able to save from thirty-six to forty-eight hours in clearing without waiting for bills of lading and agents' letters of instructions, said A. E. Clegg, vice-president of the company. These documents will be dispatched to the steamer and dropped on the deck in waterproofed pouches. The airplane will be able to maintain communication with the ship by wireless, and so find its position exactly.

The newest camera gun is mounted at the side of the regulation Lewis machine gun, and is operated by the mechanism of the Lewis gun. A new roll film of ninety-six exposures is part of the equipment. The camera gun has been invaluable for the training of aviators in aerial combat, and many bloodless duels have been fought over our aerodromes with it. A picture is registered with each shot, and the position in the picture of the other machine shows whether the "enemy" could have been brought down. A registering stopwatch is an important detail of the apparatus.

"I am looking for a cravat that will harmonize with a yellow monoplane, something not too loud in color, that will be effective at a height of sixty or a hundred feet."

Crude oil, just as it comes from the well, is a much better oil engine fuel than the residuums of the refinery, from which the lighter products have been removed. The crude contains the lighter "tops" which are easy to ignite and they, in turn, ignite the heavier constituents.

COMPRESSED
AIR
MAGAZINE

EVERYTHING PNEUMATIC
Established 1896

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We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

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OUR NEW WINGS

Just as we write these words the aeronautical exhibition in New York comes to a close. There was in a way, little of surprise for us in the exhibits, as the daily newspapers and the technical press have kept us mostly informed as to the developments and achievements in the novel art of flying. Nevertheless, the show may be taken as the landmark of a great epoch of progress.

Entirely within the present century, and while it is still in its teens, the dominion of the air has been completely won. The greatest of all the inventions of man is a proved and complete success. Our wings though new are fully fledged. There is absolutely no uncertainty remaining as to the permanency and the reliability of the service the airplane is to render. It may easily be believed that it may do more to transform the ways of civilization than was accomplished by the railroads in the century preceding.

If this may be considered extravagant, we have only to remember how great a figure was cut in the World-War by the aviator, and by what his presence and activities entailed. All the formulated military strategy of the ages became a mass of absurdities at once, and the ways and means of war were thrown into chaos. And all this was accomplished while, at the beginning, the airplane was still in the experimental stage and the art of its successful manipulation had all to be learned.

The function of the airplane is in a way the same as, and an extension of, that of the railroad. It still more belittles time and distance and brings us all closer to each other. Within a time which we may as well begin to count by days a flight across the Atlantic must go on the record, and distance will no longer be a limit. We must expect to see and must provide for regular periodical flights along numerous routes between our greater cities and for independent flight in all directions. It is high time for moving to provide aerial landing fields conveniently located, and they must soon be looked for in city maps the same as railroad stations.

But another special adaptation of the airplane is for the reaching of out of the way and otherwise inaccessible locations. It can not only go anywhere with a speed undreamed of but it can carry considerable weights. This apparent disregard of mere weight as a serious handicap was perhaps the most striking feature displayed at the aero show. The airplane is to be the facile errand boy for the world, and when we remember how our mining camps are scattered through the wildernesses they perhaps above all others may welcome and profit by the air service. Many rich mines whose working has been impracticable may now become prolific.

HOW IT LOOKS OVER THERE

After the triumphant close (for Germany) of the war of 1870-71, the acquisition of Alsace-Lorraine and an enormous indemnity with which to give a jumping ground for her trade, Germany felt ready to claim that she was the top-dog of Europe. This legend was preserved, mostly by bluff and bluster, for, as we say, a period of 48 years. Perhaps there was rather more than the shadow of substantiality in her claim of predominance, for the future historian will confirm, what the present-day observer has already noted, that, at the outset, *she was very nearly winning* the stakes for which she played.

THE FIRST MENACE AND THE SECOND

This menace, which, in the first half of the period referred to, was aimed exclusively at the Military Powers of the Continent, was directed in the second half against the naval power of this country (Great Britain). Viscount Goschen was the first to utter the cry "Halt!" to the Tirpitz scheme, which was embodied by the Kaiser in his phrase "the future of Germany is upon the water." Subsequent First Lords of the Admiralty made similar attempts to come to an understanding on naval matters with Germany, but the answer to each effort was a new Navy Bill, engineered by the ruling powers and readily endorsed by the Reichstag, and the German people, who now want to cast the responsibility upon their Kaiser alone. Almost everyone felt and knew that this naval effort was directed against Great Britain.

How could markets, with the war cloud continually hanging over them, rise or fall on intrinsic merits, when they were buffeted by military and naval events? How could they dissociate themselves from the thought of an enemy, never so dangerous as when posing as a well-wisher, never so treacherous as when masquerading as a friend? How could tranquility be preserved with a recognized foe, whose thinly-veiled object was to destroy the naval supremacy of Great Britain and the military supremacy of all others? With an army restricted to (so it is said) 25,000 men, with a navy to which by the revised armistice conditions the seal of doom has been set, *and with the League of Nations ready to keep order and punish those who break it,* the world has a chance of rest and peace such as it has never before known, and so have the Markets. *Mining World and Engineer,* London.

NEW BOOKS

Model Making, including Workshop Practice, Design and Construction of Models, by Raymond Francis Yates, New York, the Norman W. Henley Publishing Company, 390 pages 8½ by 5½ in., more than 300 illustrations, $3.

This book, by the editor of Everyday Engineering Magazine, will interest and should be of value to a large and growing class of readers. It appeals to men rather than boys. It goes quite thoroughly into the operations of the shop both in metal and in wood, and then gives descriptions in detail of a great number and variety of models which have actually been made, including the most up-to-date lines of invention, all the war developments being included.

Compressed Air Plant, by Robert Peele, Third Edition largely rewritten, New York, John Wiley & Sons, 500 pages 6 by 9 in., 246 illustrations, 50 tables, $3.00.

Professor Peele's eminently practical, thorough and reliable book has deservedly and properly come to its third edition. The original matter has been more compacted and considerable new and up-to-date material has been added giving the work even a more standard character than before. The entire contents are readily usable and there is not the slightest suggestion of padding.

The all-metal airplane, is no longer the dream it was once supposed to be. It is little, if any, heavier than its wooden prototype, and much stronger.

The Hollinger, at Porcupine, Ontario, is the richest gold mine on this continent. In 1918 it produced $6,250,000 worth of gold and paid $1,230,000 in dividends.

MACHINE-GUN COOLING PROBLEM

The Inventions Section of the General Staff is desirous of obtaining a solution of the problem of improving the methods of cooling machine guns during continuous fire, and the prevention of the freezing of the cooling liquid during cold weather when the gun is not in use.

At present the ordinary water-cooling system is used. It is necessary to transport several boxes of water for each gun in the field, as the water in the cooling jacket quickly turns into steam during firing. The following points should be observed in the solution of this problem:

1. It should be easily obtainable
2. It should be easily carried
3. It must not be too expensive
4. It must not injure the metal parts of the gun
5. If possible, it should be capable of being used several times so as to avoid extra weight.
6. A minimum of waste during use should be obtained.

It must not be assumed from the above that a cooling system for machine guns must necessarily follow the lines of the present water-filled jacket. Any efficient method of cooling will receive serious consideration.

Correspondence in regard to this matter should be addressed to the Inventions Section, General Staff, Army War College.

GOVERNMENT NEEDS BOILERMAKERS

Thirty first class boilermakers are urgently needed at the United States Navy Yard at Norfolk, Virginia. Pay ranges from $5.36 to $6.40 for eight hours. Permanent employment is assured. Thirty days leave with full pay is granted at the expiration of the first year of service and for each month thereafter, two and a half days leave are allowed with full pay. When overtime is necessary time and a half is allowed for all time in excess of eight hours. The Navy Department has authorized the Commission to furnish transportation to qualified men from point of departure to Norfolk, Virginia, if the men will agree to work for at least six months. U. S. citizens only will be considered. Full apprenticeship and good physical condition necessary. Application Form No. 1800 is required, which should be fully executed and filed with the Civil Service Commission at Washington, D. C. This form can be secured either from the Commission's office or from one of its field representatives. They are located in all of the larger cities of the United States.

THE JACKHAMER IN SOUTH AFRICAN MINES

In the course of his annual report, Mr. C. D. Leslie, the consulting engineer of the Consolidated Goldfields, pays the following notable tribute to the Jackhamer. He says: "As agriculture and industries advance it is to be expected that the supply of native labour for mining will be even less plentiful than it is at present. Approximately 41,000 natives, or double the number of natives employed on the mines of this group, are engaged in hand-drilling on the mines on the Rand, and as a means towards maintaining the rate of output on our gold mines it appears highly desirable to eliminate hand-drilling as far as practicable in favor of machines of the Jackhamer type. Extended trials with these machines at the Robinson Deep mine, as referred to in last year's report, gave very satisfactory results. It was found that each Jackhamer, employing an average of 125 natives, did the equivalent fathomage of seven hammer boys and used only 9 per cent. more explosive per fathom than was used in breaking rock by hand. In fathomage broken their duty showed an improvement of 12.4 per cent., as compared with that of reciprocating machines, which used approximately 86 per cent. more explosives per fathom broken. Considerable progress in the use of Jackhamers has been made at the Simmer and Jack mine, the result there corroborating those obtained at the Robinson Deep and justifying extending the use of the Jackhamer on each of our mines."

The Cement Gun Company, Inc., Allentown, Pa., organized by S. W. Traylor, president of the Traylor Engineering Company, will build a plant in France for the manufacture of the Traylor cement gun, to be used in reconstruction work in that country. A site is to be acquired along the Seine in the manufacturing section of Paris. The plant to be erected will cost about $500,000. Construction work will begin in February.

THE BIG ENGINEERS SHOULD BE BIGGER

The following is the substance of a principal part of an address, under another title, by Dean M. E. Cooley, University of Michigan, and President of the American Society of Mechanical Engineers, before the Detroit section of the A. S. M. E.

It is unnecessary to point out to a body of engineers what engineers have accomplished in the development of the material part of the world's civilization. The entire world, so far as its material structure is concerned, can very justly be said to be the work of the engineer, or of professional men very closely allied to the engineer and to engineering. Our great buildings, our railways, the subways of New York City, would not be possible without the work of the engineer. But it is not necessary to enumerate such features. It is enough to say that it would be difficult to think of anything that makes it possible to live the life we are living—I am speaking, of course, of the material side—that was not conceived by the engineer.

Then look at what has happened in our relations with different countries of the world through navigation on water and in the air, the latter developed to the most wonderful extent since the war began, and only in its infancy at the present moment. And look at the great conflict, with the result brought about by the work of the engineer—and the war itself brought about by the work of the engineer in the first place in helping to create commercial supremacy—fought and won by means designed and built by the engineer and I think if the engineer had the settling of the war, it would be pretty well done; but it is going to be settled by other than engineers, and it won't stay settled, you can be sure of that. I don't want to speak in any pessimistic way at all, and I don't think I am so speaking when I say that it is in my bones that the war has just begun, absolutely just begun—that is a thought for you to carry away with you. Some of you will recall your study of history and the days of Augustus Caesar, and following to the end of the decline of the Roman Empire, and at the beginning of the dark ages, when the Huns swept down and destroyed the civilization of the world. Who knows what the future has in store? Who can say that we are not going to have another dark age? I am not going to argue that we are at all—I just raise that question as something for you to think about. We are optimistic in this country. We are very optimistic with our opportunities in this country; we have no thought for the morrow except as we may make more than we made today.

I have tried to show you that the engineer stands preëminent in the world today because of his work, upon which depends so much, the civilization in which we live, and because of which we have seen also the destruction in this war of civilization.

Now, the engineer has done all these things in his professional capacity. We have wonderful experts. The different professions are filled with experts, men who know one thing and know it better than any other man in the world. It is natural that the engineer should become a specialist. It is the bread-and-butter thing for him to do. In doing this he is creating for himself a big reputation among his colleagues in engineering lines.

PUBLIC LIFE CALLS THE ENGINEER

But the engineering profession needs something more for itself, and the world needs something more from the engineer. The world needs the engineer with all his technical training to take a part in its general affairs, which up to now he has not taken. The engineer has not performed his duty to the general public. He has not given the general public the benefit of his knowledge which would enable many of the great questions which are puzzling the world today to be settled over night —if there was any desire to have them settled.

Take your Detroit street-railway situation —you may not have heard of that. It is as simple a problem as A, B, C; but does Detroit want it settled? What would be done for political capital if it were settled? I am told that the same thing is true of Chicago. The engineer's job, as I see it in such a situation, is to make it known that problems like these can be settled if the people want them settled, and that the engineers know how to settle them.

What is the best training for taking this position; going back to the college, for instance? I would say that the best training would be secured by first recasting the engineering curricula that we have. Leave out of them, at least, a quarter or half of the professional stuff that is now taught, and substitute for it the good old stuff that we used to have crammed down our throats when some of the older of us were boys or young men. I believe it to be a fact that the engineer who was graduated back in the 70's or 80's was a much more broadly educated man than the engineer who is graduated today. He was a better man to cope with the general problems that arose in the field of engineering, for the man graduated today can do only one thing, as a rule, while in those old days he could do a good many things well. While this may sound like heresy, I believe, nevertheless, that we should make our education more liberal. And if I can do one thing more before I finish my work at the University of Michigan, and one thing while I am president of The American Society of Mechanical Engineers, it will be to hammer on the one thought that we must break down the walls which we are building around the young men who are in college—walls built so high that they cannot look over. Break them down and use your influence to have them broken down. See that your boys, who are going to become engineers, are so trained that they do not have to remain privates or non-commissioned officers in an army of engineers but that they can be field officers, line officers, major-generals, lieutenant-generals of engineering, men who are qualified to be on the hilltop and look far away and have a proper perspective.

Where do you find engineers occupying big public positions, political positions, if you like? But we do not like politics. How many engineers are there in Congress, how many in the Cabinet. How many on the public service commissions? Answer those questions and you will find where the unoccupied rung is. Perhaps we cannot do much in the little of life that is left to us, but certainly we can train those who follow us, and those who follow them. We should bring up in this country a different kind of engineer, a man who by his broad education and training will stand head and shoulders above the professional man of today. That is the kind of man I want to see, and you gentlemen can do it. My message to you tonight is to awake you to a sense of your responsibilities, not alone to your own profession but as an engineer and citizen to the public.

SAFETY PRECAUTIONS FOR HANDLING OXY-ACETYLENE APPARATUS*

By E. Wanamaker

Unabsorbed acetylene, that is, in a gaseous state as generated, is highly explosive at a pressure of two atmospheres or more due to the chemical instability of the gas itself. Acetylene is more or less unstable and liable to sudden explosive decomposition under certain circumstances. Accidents sometimes occur when it is apparently impossible to guess what precipitated the decomposition which resulted in the explosion. Acetylene gas at ordinary atmospheric pressure and temperature does not fly apart spontaneously and explosively into its constituents, but does so when exposed to considerable pressure while in a wholly gaseous condition as previously stated.

It has been ascertained that acetone has the property of being able to absorb about 25 times its volume of acetylene for each atmosphere of pressure at 60 deg. F. When acetylene is dissolved in this way it ceases to be spontaneously explosive and may be stored with acetone at pressures up to 250 lb. with comparative safety. Persons not fully acquainted with the properties of acetylene gas should under no conditions be permitted to undertake the compression of it.

Acetylene gas is comparatively non-poisonous when inhaled in highly diluted form in small quantities such as might escape from small leaks; the only poisonous effects that have been observed in connection with it were due to the presence of impurities in the gas, such as phosphoretted hydrogen. Therefore acetylene should always be secured as free as possible from phosphorous and other contaminating substances.

It has been found that one pound of carbide will generate 46 cu. ft. of acetylene gas, which if permitted to leak into a room six by five feet, will mix with the air in such a proportion as to make it an inflammable explosive that may be set off by a spark as well as by a hot iron or flame. For this reason it is always well when using an acetylene torch in a small enclosed space to see that a sufficient quantity of air is obtained to prevent accidents from such a cause. A little air blowing from an air hose will prevent any such accident as this even though considerable acetylene were leaking into the space.

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*Abstract of a paper read before the Railway Fire Protection Association.

Oxygen is manufactured directly as a chemical product or electrolytically from water. Oxygen itself as a gas is non-explosive. However, it is generally stored in metal containers at a very high pressure, generally about 1,800 lb. per sq. in. It is therefore apparent that an explosion may take place due to the failure of the container itself, permitting the gas to rush out at an enormous velocity.

It has been found at times when oxygen was made electrolytically, that, due to the crowding of the pressure or careless handling, a small percentage of hydrogen was permitted to mix with the product. Certain proportions of this mixture are highly explosive and may be set off by heat or jar. It is therefore necessary that oxygen be pure.

The following instructions for handling oxy-acetylene gas are strongly recommended:

In handling acetylene gas in tanks under pressure it should be remembered that at no time should the tank be allowed to remain near stoves, furnaces, steam radiators or any other sources of heat nor should they be exposed unnecessarily to the direct rays of the sun. Care should also be used in handling acetylene gas containers to avoid heavy jars. It must be remembered that any steel drum is liable to mechanical injuries if not reasonably handled. Acetylene cylinders should always be stored in an upright position with the valve end up.

Leaking containers should never be used and should one be found, it should be set out in the open air as soon as possible away from all possibility of ignition of the gas or of the mixture of gas and air that surrounds the container.

Open flame lights should never be taken into confined spaces where there is any possibility of acetylene. In case it is found necessary to use an acetylene tank in a small enclosed space a little air should be blown into the space from an air hose in order to secure a good circulation of the atmosphere.

All acetylene containers should have fusible plugs.

Neither oxygen nor acetylene containers should ever be allowed to remain where they are exposed to sparks or flame.

Oxygen containers should not be dropped nor handled roughly in any way and should not be placed where they may be overturned by a collision with other objects or by reaction caused by the violent escape of their contents through the safety outlet with which containers should be provided.

The regulating devices, valves and other attachments on oxygen containers should never be lubricated with oil or grease. Whenever lubrication is required it should be secured by the use of pure graphite unmixed with either oil or grease. Furthermore the discharge valves of oxygen tanks should always be opened slowly and care should be taken to avoid twisting or straining them by the use of hammers or improper wrenches.

The hose and hose connections used between the gas manifolds or gas tanks and the welding torch must always be maintained free from leaks and all joints made mechanically tight and secure. The regulating valves and torches must be kept in good state of mechanical repair to avoid leakage of the gases. No part of the equipment to which hose is attached should be used without securing the hose with the proper size hose clamp. Wire fastenings should not be used in any case.

In case of any trouble with the torch the gas should be immediately shut off at the tanks or pipe line station.

Where generating stations are used the instruction cards sent with the parts must be carefully followed and no leaks must be permitted on any of the pipe lines.

No man should be permitted to use the gas welding torch until properly instructed by a welding supervisor or some experienced welder, and if he is not the regular operator permission of the foreman in charge should be obtained before the machines are used.

Safety gages should be used on all regulators, that is, gages having loose or vented backs, so that in case the pressure on the gage builds up to a dangerous degree or builds up too rapidly, such as might cause a rupture of the Bourdon tube the force will spend itself without breaking the glass case, thereby causing possible injury to the operator.

Some shops use portable welding outfits, purchasing tanked gas and tanked oxygen. Other shops install acetylene generating outfits, also oxygen generating outfits, piping the gas throughout the shops having manifold outlets to which the hose from the welding torches are connected. Still other shops generate acetylene gas and purchase tanked oxygen, connecting it to a manifold which in turn is connected with a system of piping in much the same manner as the oxygen generating plant. Each generating plant that is installed is equipped with a complete set of instructions for intelligently operating the generator, the most important of which are: "Remember to keep all light or fire of any kind away from the plant and never permit the generator to remain more than five minutes unless the generating chamber is filled with water, even when it is not in use." If the instructions that we have given in this paper and the detailed instructions which are given out with the generators are carefully followed out and leaks of all kinds prevented in the distribution piping system of the installed plants, there will be practically no danger from fire.

A MINE RESCUE RECORD*

On the morning of January 20 the fire bosses at Mt. Braddock mine discovered smoke in the return air current, and the men were not permitted to enter, except six who went in to start the pumps and locate the fire. The mine is a slope and the active workings are about a mile and three-quarters from the opening. The main haulage slope is paralleled by the manway, both of which being return airways. The fire was on the intakeairway and all the gases generated were being carried through the mine.

Three men from the Orient Rescue Station arrived early in the afternoon with breathing apparatus and entered the mine by way of the main slope, traveling down about 4,000 ft. through the smoke to the main parting, where they found two men, one unconscious, who had found a leak in a compressed air pipe and remained at that point. Both men were unconscious when they reached the surface and were taken in hand by John C. Struble, inspector for the H. C. Frick Coke Company, who had just arrived with his rescue team, and by means of artificial respiration and oxygen were revived. Mr. Struble decided to change the ventilation and prevent the fire gases from getting to the section where the other four men were supposed to be. His rescue crew, with breathing apparatus, constructed a temporary brattice.

The Bureau of Mines at Pittsburgh got away five men in twenty minutes after receiving word, but they were stopped on the way by mud roads and were picked up by Stephen Arkwright of the H. C. Frick Coke Co. and S. J. Ryan of the Mine Safety Appliance Co. and all arrived about the time the brattice was completed.

An exploring party of ten men equipped with breathing apparatus, safety and electric lamps and a canary, entered the mine following the run intake. In following the fresh air they traveled a circuitous route, carefully chalking their way, and after two and a half hours reached the main haulage slope. Before passing the door separating the intake and return two men went ahead examining the return air with safety lamps and the canary. The air being clear the party went through the door to the slope, located a telephone and made a report to the outside. Following a rest, the rescue crew proceeded down the left slope where two men were supposed to be at a pump, and after traveling about 600 feet they saw a light approximately 400 feet ahead, apparently in the hands of someone staggering, which they approached cautiously and found Charley Terch, who fell to the ground when they reached him. He was given oxygen from one of the breathing apparatuses and quickly revived and was able to tell that his "buddy" was back along the slope somewhere unconscious.

The other members of the party then proceeded down the slope and found Elmer Matthews about 3,000 feet from the parting, or about 2,000 feet beyond the first man recovered. They revived him after a time with artificial respiration and oxygen, but he was unable to walk and was carried back to the parting, where he responded to first aid treatment. These men were unable to give any information as to the location of the other two men, so after a conference it was decided that they were evidently in the vicinity of the other two pumps, which were located at the bottom of the right hand slope. Arkwright, Parker and Ryan, with five men and apparatus proceeded down the right slope to explore for the other two men, leaving the other members of the rescue party to look

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*Condensed from *The Coal Industry*.

after the two recovered men. The latter party communicated with the surface and had a trip sent down with blankets, stretchers, hot coffee and other stimulants.

Arkwright's party located the two pumps, but found no trace of the men other than a safety lamp. After exploring all the working places, they started out the manway and found James Russell, who was partially conscious and quickly responded after oxygen was given him. He had no idea of where he was or how long he had been there and could give no information about his companion. Two of the party remained with him and the others continued up the manway and found Frank Largon about 300 feet beyond. He was in bad condition and did not respond to treatment for approximately a half hour, and while three of the party worked on him, the others returned to the main parting for stretchers and assistance, upon the arrival of which two men were carried out to the parting and were given stimulants and plenty of oxygen. Largon had made up his mind that he was going to die and he apparently did not want to change his mind and refused to breathe the oxygen, and at one time the whole party was working on him, rubbing him, holding safety lamps around him to keep him warm and trying to get him to take stimulants and oxygen. He finally wanted to fight Struble and the anticipation of this pleasure was sufficient inducement for him to decide to get well.

Now came the problem of getting these four men to the surface, 4,000 feet, by way of the slope, the most direct route. It was plainly evident that it would be impossible to carry them back. They were also confronted by the fact that, while the air was good on the slope at this point, about half way up the slope the return from the fire section joined the return on the haulage slope. To determine the condition of the air it was decided to send a canary and some safety lamps on the trip. As soon as the trip reached the surface they examined the canary and found it had been overcome, and the safety lamps had been extinguished. This information was communicated to the party underground and after a conference it was decided to have additional rescue apparatus sent down for the four recovered men and those whose oxygen was partially exhausted; also to send a fresh canary and additional safety lamps to again check the condition of the air. Fortunately there was plenty of apparatus on hand as additional apparatus had arrived. The above program was quickly carried out and when the trip arrived at the parting the canary was overcome but the safety lamps were burning. The four rescued men were placed comfortably in separate cars and apparatus placed on them and two of the rescue crew were assigned to each car in which the men were placed. All of the apparatus was tested out carefully, and after 11 of the party were placed, McCaa and Zorn examined each apparatus and turned on the oxygen, then examined each other's apparatus and got aboard. Struble at the telephone gave instructions to hoist in two minutes, which seemed like an hour. The trip started and in 10 minutes the 14 men, all wearing breathing apparatus, reached the surface in fine shape, 8.10 A. M., January 21. The four rescued men had been underground just 24 hours and the rescue party 7 hours, having entered the mine about 1 A. M.

LOCATING SUBMERGED SUBMARINES

Many devices have been thought out and perfected during the present war for locating enemy submarines when submerged. According to an article in *L'Illustration* for February 8th, the French claim that the more recent successes were due to an invention of one of their officers, Captain Walser. This inventor's idea is based on the refraction of sound-waves when transmitted from one medium to another. When coming from a source situated some distance away these waves are parallel, and remain so on condition that their propagation is unimpeded. In practice, the device consists of an "acoustic" lens, which causes the waves to converge to a centre—which in this case is inside the observation boat—when they are strengthened and capable of isolation. The different points of emanation set up as many distinct foci as there are points, the geometric loci of these foci being approximately a circle. As the seat of the foci depends on the direction in which the sound is travelling, the position of all may be deduced from a knowledge of the position of one of them. The lens is formed by a number of discs, capable of vibration, which cover a number of holes drilled in plates placed on each side of the vessel, these plates replacing the hull itself at these particular parts. The sound is transmitted to sound-horns capable of suitable motion by special gear. When the observer is listening, the horns—one on each side—are trained by him until they arrive at the position corresponding to maximum intensity. Either empirical or comparison methods are used in judging the distance away of the submarine whose bearing is sought. The apparatus described closely resembles the hydrophone originally developed for use with submarine bells, and during the war employed for the detection of submarine boats, &c.

NOTES

The headings of the Otira tunnel, New Zealand, were joined in August. The tunnel is five miles twenty-five chains in length, and has been under construction since May, 1908. Owing to scarcity of labour and material it cannot be completed for another two years.

The Automobile Chamber of Commerce announces that at a joint meeting of committees representing tire and aumobile manufacturers, it was decided that all restrictions that had been adopted as a war measure on the manufacture of certain sizes and styles of pneumatic tires for renewal purposes would be removed and that tires of all sizes would be made as long as there is a demand for them by the public.

Fearing that returned soldiers will attempt to make use of the army gas masks in coal mines or other places where poison gas may have accumulated, Director Manning of the Bureau of Mines makes the following statement: "The army gas mask should never be used in mines, because of the uncertainty that exists as to the amounts of gases in the atmosphere and the liability of there being insufficient oxygen to support life. Its use in the mines will lead to serious accidents and fatalities."

Carbon dioxide has been successfully used in Australia for exterminating the weevil which has been destroying stored wheat in vast quantities. The infected wheat is stored in air tight stackhouses into which carbon dioxide is pumped until the live weevils are destroyed. The eggs and grubs which remain are killed by heating the wheat in special machines to 140 deg. F. for three minutes. It is claimed that the character of the wheat is unaffected and that there is no tendency for weevils to develop again unless exposed to a fresh source of infection.

A novel ship repair job has been recently carried out in Buenos Aires. The ship was a wooden vessel called the Paloma Argentina, of some 200 tons displacement. The wooden ribs of the vessel were quite rotted away at the bottom, and the repair consisted in casting in armored concrete ribs between the existing wooden ribs, the ribs being bonded to the skin by coach screws driven partly into the latter. Here and there extra deep concrete ribs with special reinforcement were taken over the inner or false keel. The repair is reported to be quite successful, and as the concrete takes the place of ballast, has added nothing to the weight of the vessel.

The last annual report of the Bureau of Fisheries states that the Bureau coöperated with the public Health Service in the task of protecting soldiers from malaria in one of the large southern cantonments. All available means were used to protect and increase the supply of top minnows (*Gambusia*) in the adjacent waters and careful observations were made on the effectiveness of these and other fishes in the extermination of mosquito larvae. It has been fully demonstrated, says the report, that small fishes are in many cases most effective agents for the control of mosquitoes, but their effectiveness depends upon various conditions, such as the presence of dèbris and of plants of various species, wave action, fluctuations of level, etc., and definite knowledge is lacking concerning the part played by these factors.

The City of Milwaukee has been greatly bothered with a peculiar taste in its drinking water. This water is obtained from the lake and is chlorinated before distribution. At first it was thought that the chlorine produced the taste, but a series of tests proved that this was not the source of the contamination. There seemed to be some connection between the intensity of the taste and the direction of the wind, and finally the source of trouble was located in a couple of plants, one three miles away and the other eight miles away, which were producing coal tar products. Quantities of phenol were allowed to escape in the waste, and upon test it was shown that this would produce a noticeable waste, even when diluted to one part of phenol in 500 million parts of water.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

JANUARY 7.

1,290,155. AIR-CHAMBER FOR PUMPS. Norman O. Fleming, Huntington Park, Cal.

1,290,241. ART OF PURIFYING FIRE-CLAYS. Henry L. Kohler, St. Louis, Mo.

1,290,291. PRESSURE-RELIEF APPARATUS. Herbert B. Morrill, Salem, Mass.

1,290,334. OIL-BURNER. Harry A. Paxson, Altoona, Pa.

1,290,389. POWER REVERSE-GEAR. Jacob Rush Snyder, Pittsburgh, Pa.

1,290,459. MACHINE FOR MIXING AND PLACING CONCRETE AND OTHER MATERIAL. Wylie Gemmel Wilson, Elizabeth, N. J.

1,290,461. PNEUMATIC ACTION FOR AUTOMATIC PLAYING MECHANICS. Luman Birch Wing, Brooklyn, N. Y.

1,290,607. AIR-REGISTER FOR OIL-BURNERS. Luther D. Lovekin, Philadelphia, Pa.

1,290,643. PNEUMATIC DOOR-CHECK. Hjalmer A. Nelson, St. Paul, Minn.

1,290,662. PRESSURE - PRODUCING APPARATUS. George D. Pogue, St. Louis, Mo.

1,290,703. AIR-LINE EXHAUSTER FOR STEAM-HEATING SYSTEMS. Joseph H. Brady, Kansas City, Mo.

1,290,756. HOT-AIR ENGINE. Alexander T. Kasley, Swissvale, Pa.

1,290,758. PNEUMATIC TUBE OR CHUTE. Henry P. Kraft, Ridgewood, N. J.

JANUARY 14.

A wave force utilizing device comprising an inclosure having an inclined wall dividing said inclosure into a wave receiving and a water confining chamber, a plurality of valves on said wall arranged to be opened by incoming waves and confine water in said chamber, an outlet on said confining chamber, a compressible bag in said chamber, an air supply pipe for said bag, and a valve controlled air outlet for said bag.

1,290,875. AIR-SPEED INDICATOR FOR AEROPLANES. Abram T. Baldwin and Sigwurd L. Christenson, Detroit, Mich.

In an air speed indicator, a movable element adapted to be subjected on opposite sides to different pressures, means to laterally adjust the position of said element and an indicating element movable in a plane at right angles to the plane of movement of said movable element and connected with it.

1,290,994. COMPRESSOR FOR REFRIGERATING SYSTEMS. Clarence M. Holley, Detroit, Mich.

1,291,016. FLUID-CUSHION DEVICE FOR AUTOMOBILES. Charles Snow Kellogg, New York, N. Y.

1,291,099. AIR-EXHAUST AND VACUUM SEAL VALVE. Lewis F. Ostrander, St. Louis, Mo.

1,291,130. EDUCTION-PIPE FOR AIR-LIFT PUMPS. Arthur William Purchas, York, England.

An eduction pipe for air lifts, the cross section of which varies in steps, the maximum cross section being at the bottom and adapted to be submerged, the minimum cross section following the maximum cross section, the section larger than the minimum but smaller than the maximum following the minimum section.

1,291,456. PNEUMATIC APPARATUS FOR TAKING OFF SINGLE SHEETS FROM PILES. Shimon Feldman, Petrograd, Russia.

1,291,488. METHOD OF PNEUMATIC CONTROL OF VARIOUS MECHANISMS. Walter G. Haas, Dayton, Ohio.

1,291,504. AIR-PUMP. George Edgar Hazard, Rochester, N. Y.

1,291,520. ROTARY COMPRESSOR. Conrad Hoerl, Newark, N. J.

1,291,589. PROCESS FOR THE COMBUSTION OF GAS. Harry R. Maxon, Muncie, Ind.

A process for the combustion of gas which consists in supplying gas and air to a mixer, regulating the gas and air to the relative proportions required for complete combustion, mixing the gas and air, conducting the resultant mixture to a burner, burning the mixture, and maintaining the speed of flow of the mixture at the lowest rate necessary to prevent back firing.

1,291,609. AIR-COMPRESSOR VALVE. Samuel Z. Nichols, Milwaukee, Wis.

1,291,670. PNEUMATIC ACTION FOR AUTOMATIC MUSICAL INSTRUMENTS. Hervey Evelyn Gamble, London, England.

JANUARY 21.

1,291,802. SUCTION-CLEANER. Ora Drake, Cleveland, Ohio.

1,291,854. UNLOADER FOR COMPRESSORS. Harry V. Haight, Sherbrooke, Quebec, Canada.

1,291,862. FLUID - PRESSURE - ACTUATED VALVE. Mark L. Harned, Washington, D. C.

1,291,875. COMPRESSOR - CONTROLLING MEANS. Herbert T. Herr, Pittsburgh, Pa.

1,291,983. COMPRESSOR. Gustave F. Maisch, Chicago, Ill.

A gas-compressor in combination with a lubricant reservoir, and means actuated by the gas operated upon by the compressor to feed the lubricant from said reservoir to its place of use, substantially as described.

1,292,038. TURBINE-ENGINE. Peter Phillip, Chicago, Ill.

1,292,077. ELECTRIC CONTROL OF FLUID-PRESSURE-ACTUATED MOTORS. Harold Rowntree, Kenilworth, Ill.

1,292,318. AIR-BRUSH. Birchard E. Holton, Los Angeles, Cal.

1,292,362. PNEUMATIC ACTION FOR MUSICAL INSTRUMENTS. Joseph A. Obst, Pawtucket, R. I.

JANUARY 28.

1,292,430. CAR-DOOR-OPERATING MECHANISM. William M. Cady, Edgewood Park, Pa.

1,292,549. FUEL-FEEDING SYSTEM. Frank E. Wellman, Kansas City, Kans.

1,292,562. ART OF COOLING AND DRYING AIR. William J. Baldwin, Brooklyn, N. Y.

1,292,665. AIR-GUN. Ude P. Udesen, St. Paul, Minn.

1,292,731. COMPRESSED-AIR POWER PLANT. Henry P. J. Earnshaw, Boston, Mass.

1,292,851. LIQUID-ELEVATING APPARATUS. Thomas W. Murphy, Philadelphia, Pa.

1,292,898. APPARATUS FOR SPRAYING AND ATOMIZING LIQUIDS. Eli Slater, Kinders, Greenfield, England.

1,292,905. AIR-PUMP. Samuel A. Snell, Mineral Ridge, Ohio.

1,292,940. GLASS-BLOWING MACHINE. Arthur Wilzin, St. Ouen, France.

1,292,963. VACUUM-CLEANER. Daniel B. Replogle, Berkeley, Cal.

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CENTRALIZED COMPRESSOR PLANT VERSUS INDEPENDENT COMPRESSORS

BY FRANK RICHARDS

I was very much interested in the article in the *American Machinist*, Feb. 27, page 395, [COMPRESSED AIR MAGAZINE, April, 1919, page 9106] giving an account of the employment of compressed air for various operations in the manufacture of 155-mm. shells at the works of Winslow Brothers Co., Chicago, Ill. Many establishments were rushed last year in the production of munitions, and the plant among them which did not use compressed air for some of its work would have been a curiosity. In the example above referred to, the special uses of the air were for the chucks on lathes and boring machines, for varnishing and for sandblasting the shells. I was especially interested in the following portion of the detailed description which I here reproduce verbatim:

"An interesting feature of the air-compressing installation is that, instead of being grouped centrally in a power house, it is distributed about the plant at convenient points where the air is most used. This saves long lines of piping and makes for efficiency, as it obviates to the greatest possible extent drop in pressure, due to friction in the transmission line caused by elbows and turns."

Now, I feel compelled to say at once without hesitation and without apology, that while the feature to which attention is thus called is certainly "interesting," it is also to me most surprising. It is at variance with all experience and practice, and the claimed advantage is absurd. A single compressor could have been installed in the power house of the works, or anywhere most convenient, the air could have been distributed throughout the establishment, and the pressure maintained so that there would not have been more than 1 lb. of pressure drop at the remotest point. This may be substantiated by the records of hundreds of compressed-air installations where the pressures carried are anywhere up to 80 or 90 lb. gage, and the distribution areas very much larger than in this case. Here there were four similar compressors, two-stage, with air cylinders 14 in. and 8¾ in. respectively, with a common stroke of 10 in.—quite small machines as compressors go today. A single machine, the exact equivalent of these in theoretical capacity, would have had at the same piston speed, air cylinders 28 in. and 17½ in. in diameter; but, with the greater piston speed permitted to the larger machine, air cylinders 24 in. and 14 in. in diameter would have fully equalled the air output.

Under the conditions which rule wherever compressed air is employed, and especially was it so in this case, the air is used intermittently, and the demand for the air at the source of supply is irregular. The consumption of air in operating the various chucks spoken of must have been very small, since they are worked by static pressure and not by flow or loss of air. By far the larger volume of the air, we must assume, was used for the varnishing and the sandblasting, and especially the latter, since for these, when actually operating, there would be a continuous discharge of air; but here too the work was not continuous for any machine, and the machines would seldom, if ever, be operating all at once.

The demand for air from each of the four compressors was of course never coincident with that of either of the others. The air demand would have been much better averaged and equalized if all the air had been drawn from a single compressor, and a single air receiver, approximately equal in capacity to that of the four smaller ones would have been better to meet the demand.

Having regard to the fluctuating and unequal air consumption, it would seem, from all that appears, and from all that may be legitimately inferred, that a single central compressor with cylinders 20 in. and 12½ in. in diameter would have afforded a sufficient supply of air in this case. The cost of such a machine might be about one-half of that of the four smaller ones. The single line of distributing pipe would probably cost less than the extra shafting, pulleys and belts, and the piping for cooling water for the four isolated machines. The extra cost of attending the four separate machines, the multiplicity of the lubrication, the fourfold liability of stoppage for repairs, need not be spoken of.

The article which we have been considering calls attention to the special air-drying arrangement provided for the air to be used for the sandblasting. With a single air compressor, an effective aftercooler and a separator, the latter operating upon the air when at its highest pressure and at its lowest temperature, or when its moisture carrying capacity would have been at the minimum, would have provided the advantage of dry air for all the purposes for which it was used, instead of for the sandblasting alone.—*American Machinist.*

A PNEUMATIC SCRAPER FOR FINE MACHINE WORK

One of the most responsible and delicate operations of the machinist, requiring both skill and perseverance, is the scraping of metal surfaces, usually cast iron, where minute accuracy or fine precision of fit is required, as in valves and valve seats and the slides of lathes, planers and other machine tools. The operation is usually entrusted only to workmen of long training and it has hitherto been regarded as strictly a hand operation.

The Anderson Brothers' Manufacturing Company, Rockford, Ill., is now building an air driven scraping tool which is a demonstrated success and a valuable acquisition in high class machine shop equipment. The illustrations here presented and most of the accompanying description are reproduced from the April issue of *Machinery.*

The scraping tool, seen in actual use in Fig. 1, is carried at the end of a long arm, and the air cylinder and operating parts are located at the opposite end of this arm. To facilitate the manipulation of the tool this air cylinder and its auxiliary mechanism are carried by a trolley which may easily be run back and forth on the supporting rail in order to enable the scraping tool to reach exactly the desired position on large pieces of work. The operator holds the scraping tool firmly down onto the work with the left hand, and the right hand is used to manipulate a knurled sleeve which actuates a valve in the air cylinder. When this knurled sleeve is pushed forward it allows the air to enter the cylinder and forces the scraping tool forward. As the only effort required of the operator is to hold the tool down onto the work he is relieved of the additional effort of pushing the tool forward, and as a consequence he does not become so tired during the latter part of the day that his working efficiency is greatly reduced.

The trolley rail and trolley by which the heavy end of the tool is supported will be seen up at the left in Fig. 3. The lower views are arranged as shown to illustrate the design in more detail, attention being called to the fact that when the tool is ready for use, threaded fit *B* is assembled into socket *C*, and a pin passes through hole *D* at the right hand end of the valve rod and hole *D* shown in the

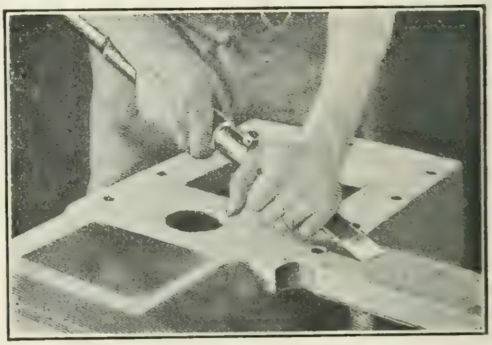

FIG. 1

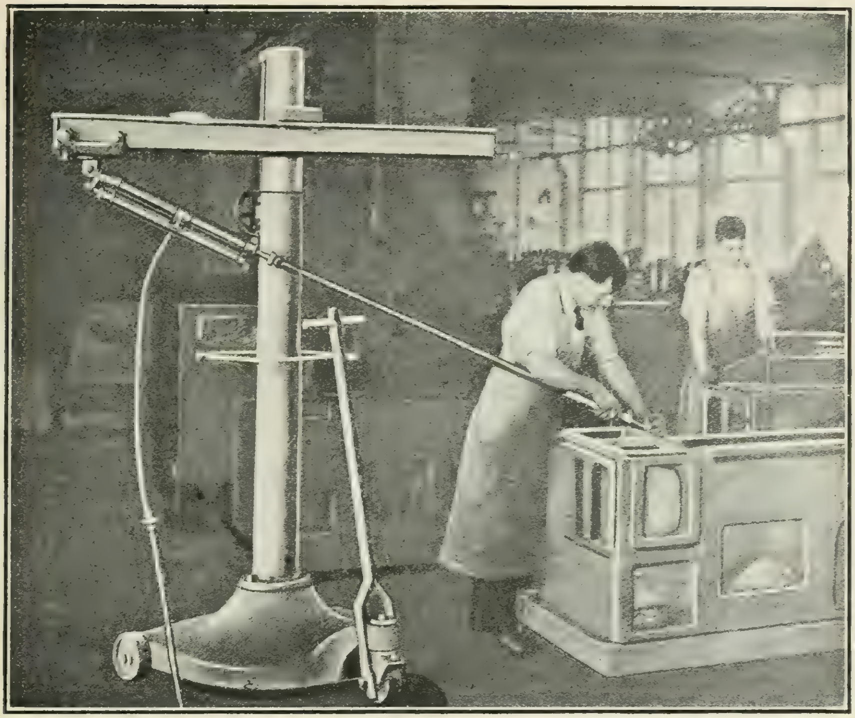

FIG. 2

lower view, in order to provide for connecting the valve rod with knurled sleeve *E* which controls the operation of the scraping tool. When the knurled sleeve *E* is pushed forward it opens valve *F* and allows air to enter the space *G* in the cylinder behind the piston.

It will be seen that the piston is connected by means of posts, all of which are designated by the reference letter *H,* with the scraping tool which is mounted at *A* at the right hand end of rod *H* and secured by the setscrew shown. When knurled sleeve *E* is pushed forward to open valve *F* and admit air behind the piston, it causes the piston to move forward, and through this direct connection a similar forward movement is imparted to the scraping tool carried at *A*. The length of stroke may be governed either by releasing sleeve *E* when the tool has reached the desired point on the work, or by allowing the piston to travel forward until such a time as it reaches the exhaust ports which allow the air pressure behind the piston to be released. The valve *F* is normally kept in the closed position by means of a spiral spring *I,* and when the valve is closed, back pressure of air against shoulder *J* on the piston causes the piston and the scraping tool to be returned to the starting position.

When the scraping tool starts to move forward on its working stroke, it would be undesirable to have the trolley which supports the back end of the tool move along the rail. This possible cause of trouble has been effectually overcome by providing an automatic clamping mechanism which locks the trolley to the rail at the same time that the scraping tool starts on its working stroke. The way in which this result is accomplished is as follows: When valve *F* is opened to admit air behind the piston, some of the air also passes through port *K* to the swivel point between the air cylinder and the trolley. Just below the trolley there will be seen a detail view of the bolt which connects the back end of the air cylinder to the trolley. After passing through port *K* the air enters an annular space *L* beneath the nut on this bolt and thence passes through ports *M* to reach an annular groove *N* that is cut around the body of the bolt at

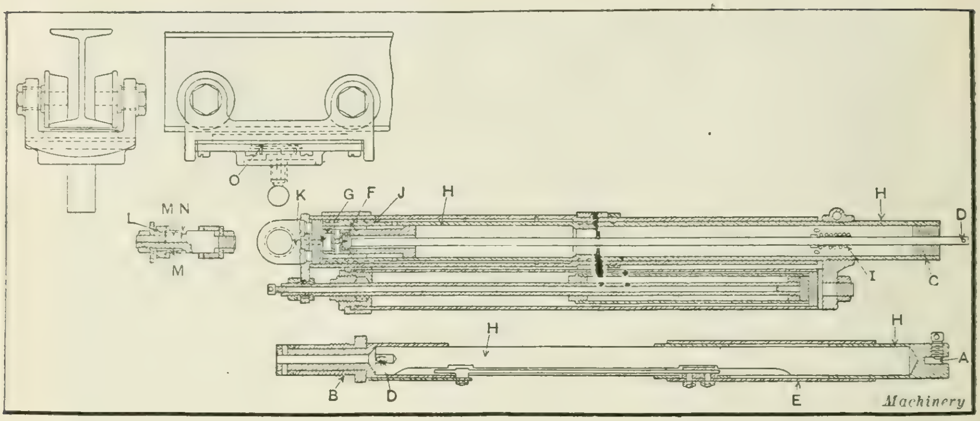

FIG. 3

the center. From this annular space the air passes up to a diaphragm *O* which locks the trolley to its rail during the time that the air pressure is admitted to provide for driving the scraping tool forward. When valve *F* in the air cylinder is closed to shut off the pressure and stop the working stroke of the tool, the air pressure on diaphragm *O* is also released so that the trolley is free to move and allow the scraping tool to reach any other desired point on the work.

The speed of the forward stroke of the scraping tool is regulated by an oil governor. About eight cubic feet of free air per minute, at a pressure of eighty to ninety pounds per square inch is consumed in operating this tool, although this fact is of very little importance. The rod that carries the scraper is mounted on ball bearings so that it may be turned over to enable both sides of the tool to be used in the same way that a hand operated tool is employed. This arrangement also enables the tool to adjust itself to the work, regardless of the angle of the surface that is being scraped, although it will usually be approximately horizontal.

The rail on which the trolley is carried may be supported in any convenient way; it may be either secured to the ceiling of the shop or mounted upon a special pedestal base designed for the purpose as shown in Fig. 2. This pedestal enables the height of the rail to be adjusted to suit different requirements.

AIR COMPRESSORS AND RECEIVERS FOR DIESEL ENGINES*

BY HERBERT HAAS

The air required for starting the engine and for atomizing and injecting the fuel is furnished by an air compressor. On account of the high pressure necessary the air is compressed in two or three stages. Ample cooling of the compressor cylinders and of the air in intercoolers between stages is not merely desirable, to approach isothermal compression, but is necessary to avoid accidents that might wreck the compressor, with possible injury to the operators. With insufficient cooling of air and excessive use of cylinder lubricating oil, or of an unstable oil, the oil vapor may form an explosive mixture with the heated air and be ignited by compression. Three-stage compression is therefore much to be preferred, as it permits compressing the air more gradually, and the lower compression-ratios avoid excessive terminal temperatures.

AFTERCOOLERS

The air leaving the last compressing cylinder should be placed through an aftercooler and an oil separator before it is stored in the air receivers. This step is taken not so much to prevent a drop in pressure in the injection air bottle, with the contraction of the heated air in cooling, as to avoid explosions of the

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*From a continuous treatise on the Diesel engine in current issues of *The Gas Engine*.

heated air charged with oil vapor. Regrettable accidents have happened from failure to provide intercoolers and aftercoolers. Not only pipes but air receivers as well have burst. Flame passing through the air pipe and into the air receiver charged with oil vapor has ignited this vapor and blown up the receiver. The aftercooler cools the air, and the oil-and-water vapors are condensed in the separator, and from time to time are drained off.

The air compressor should be lubricated thoroughly, but without the use of an excessive quantity of oil. The oil used should have a paraffin base, should be of great stability at high temperature, and should have high flash and burning points.

COMPRESSOR ARRANGEMENTS

The air compressor is usually driven direct from the main shaft of the engine. On multicylinder engines with closed crank case the compressor usually has the appearance of an additional cylinder, the compressor cylinders and pipe coil air coolers being surrounded with a mouth forming a water space.

On some engines, especially large units, more than one compressor is used to avoid the large size necessary with only a single compressor. Moreover, greater accessibility and reliability are obtained, and the work of compression is divided into a larger number of smaller absolute impulses.

Compressors may be vertical, horizontal or inclined for both horizontal and vertical engines. They are made of cast iron, with water jacketed cylinders, or are surrounded by a mouth which forms a large water space and in which are housed the air cooling coils. More systematic cooling can be done by using water jacketed cylinders and independent intercoolers. Also, these then become more accessible. The cylinders are stepped down to correspond to the number of stages.

The valves are metal pappet or disk valves. The discharge and intake valves between stages are perferably housed together in one cage, of a construction that facilitates their removal and replacement. The high pressure demands small clearance spaces; the interior of the cylinder head end should conform closely to the inner surface of the cylinder; the end of the piston, likewise, should conform to the shape of the cylinder head to permit its close approach. Each inter-cooler should be fitted with an oil separator, so that excess lubricating oil and condensed water may be separated and drained off and not allowed to pass on to the next stage.

A blow-off (safety) valve should be placed in the high pressure air pipe leading to the air receiver, directly back of the high pressure end of the compressor (past its discharge valve), to prevent the bursting of the pipe as the result of any obstruction.

Compressor troubles are probably responsible for a large proportion of the shutdowns in the operation of the Diesel engine. Particular care should be used in compressor construction to make all the parts as simple as possible and still retain the maximum efficiency and reliability. Valves should be readily interchangeable, and the material and workmanship of the highest order.

AIR RECEIVERS

The air from the compressor is usually stored in three air receivers, two large ones for the air used in starting the engine and a smaller one for the injection of air. These receivers are made of seamless drawn steel, and to avoid heavy walls and excessive weight are relatively long and of small diameter ($L/D=4$ to 8). They are interconnected with a system of pipes controlled by valves, so that either of the large bottles may be replenished with air from the injection-air bottle, which is supplied from the air compressor. The valve bodies are machined out of solid forged-steel blocks. The valve bodies are connected to the air pipes by copper cones and steel gland nuts. The valves are controlled by large (8-inch) handwheels.

One of the large air bottles is used for storing a reserve supply of air under a pressure of 1,000 pounds per square inch. Air is drawn from the other when the engine is started. The latter bottle is refilled as soon as the engine is in operation. The air compressor is designed amply large to replenish, in 15 to 20 minutes running, the air so used, without drawing on that used for injecting the fuel with the engine at full load. Manometers are provided to indicate the pressure in the large bottles and the injection-air bottle and the intermediate pressure of the compressor. At least one of the large air receivers is filled with air at the manufacturer's works and shipped with the engine to be used in starting it for the first time. Before the engine is started at any time the operator should convince himself that every part of it is in operating condition; should he fail to start it by turning on the starting air, he should close the air valve at once and locate the cause of failure rather than make a number of attempts and waste the compressed air.

If all the air has been used before the operator has succeeded in starting the engine, which operates the compressor for producing a fresh supply, compressed carbon dioxide (carbonic-acid gas) can be used in lieu of compressed air. To prevent the freezing of the gas when it is drawn, the top part of the container may be warmed by wrapping cloths soaked in hot water around it. The container should not be heated by such means as torches, as there is great danger of bursting it from overheating the gas.

The size and the number of air receivers vary with the size of the installation. In power plants using a number of engines it is well to interconnect the air receivers of the different engines, so that any one can be drawn upon in emergencies for any of the engines. Small engines need a relatively greater air-storage capacity for horse-power than do large engines. The capacity required varies from 15 to 20 gallons per 100 horse-power for the injection-air bottle and from 60 to 200 gallons per 100 horse-power for the starting-air receivers.

REGULATION OF AIR SUPPLY

The air supply to the fuel valves is regulated by throttling the discharge valve on the injection-air bottle, and the desired pressure, indicated by a manometer on the injection-air bottle, is maintained by correspondingly throttling the air going to the air compressor at the air intake.

Each bottle is provided with a cock and a drain pipe reaching to the bottom of the bottle to drain it of accumulated condensed water and oil.

For starting some engines low-pressure air is used (100 to 250 pounds per square inch), which is stored in the standard type of sheet-steel, riveted air receivers. The receivers are filled with air drawn from the injection-air bottle and supplied by the air compressor. In other engines the air receivers are eliminated together and a seamless steel pipe is used between the compressor and the fuel valves, the pipe taking the place of the injection-air bottle. A separate small compressor driven by a gasoline engine supplies the starting air. This practice lowers the first cost of the engine, but the absence of any reserve makes it necessary that the compressor furnishing the injection air be of unfailing reliability. With the opening and closing of the fuel valves and the lack of sufficient receiver capacity the pressure fluctuates, and with an obstruction in the pipe the pressure may rise abruptly and burst the pipe, as even the precautionary blow-off valves can not be depended upon to act unfailingly. The presence of a gasoline engine with its highly inflammable fuel introduces a fire risk that is absent in installations that derive the starting air from the engine-driven compressor and have in the engine room only a small supply of fuel oil with a high flash point. This advantage of the Diesel engine should not be appraised too lightly in many industrial plants, such as textile and flour mills.

MATERIAL FOR THE AIR PIPES

The injection-air and fuel pipes subjected to the fuel-pump pressure are made either of seamless-drawn copper or steel. Copper pipes are preferable on account of their greater ductility and uniform strength, even though they have a lower tensile strength than steel pipes. Seamless drawn-steel pipes have failed, owing to local imperfections, where copper pipes have satisfactorily stood the test; but no receiver system or pipes are entirely safe against rupture if the air discharged from the air compressor is not first cooled to remove any entrained oil. For conducting the air used in starting the engine a seamless drawn-steel pipe is used; this pipe is of larger diameter and, as the pressure of air used for starting should not exceed 500 pounds per square inch when admitted to the engine cylinder, is safe. This air is usually at atmospheric temperature and the danger from ignition of explosive mixtures of air and oil vapors is absent.

For circulating cooling water and supplying fuel oil to the fuel-storage tank in the engine room standard black or galvanized-iron pipes are used.

SOURCE AND VOLUME OF AIR USED

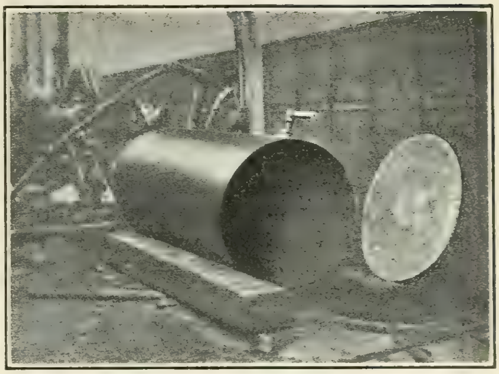
The air for the engine is taken directly from the engine room or from the outside. If the air is taken from the engine room, the customary method is to bolt to the facing of the cylinder head a cast-iron elbow, connecting this with the intake to the air valves; the elbow points downward and is connected with a short length of steel pipe (one elbow and one pipe for each cylinder). Its end is closed with a cap. The air enters through a series of long slits cut into the walls of the pipe. This arrangement lessens the noise and prevents foreign bodies from being drawn into the engine.

As the volume of air drawn into the engine is considerable—about 635 cubic feet per minute for a 100-horsepower engine having a four-stroke cycle and about 850 cubic feet per minute for an engine having a two-stroke cycle—especially in large installations, means of admitting an excess of air to the engine room must be provided. However, the noise will probably be considerable and the windows will vibrate and shake under the continuous waves produced by the periodic air displacements. It is therefore a better plan in large installations to draw the air from the outside through large conduits built in the foundation and connecting with the different air intakes to the valves.

EXPLOSION OF A "WELDED" AIR RECEIVER

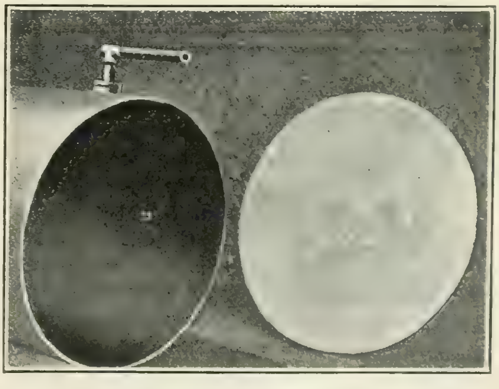
R. L. Hemingway, Chief Boiler Inspector, California Industrial Accident Commission, exhibits in *California Safety News* the illustrations, which we here reproduce, "as a warning," so he says, "against welded heads of air pressure vessels."

The exploded receiver here shown was mounted in connection with an 8 by 10 in. compressor driven by a 13 h.p. motor. It was 28½ in. in diameter and 6 ft. long. The shell, also welded was .194 in. ($^{3}/_{16}$ +) thick and the heads .259 in. (¼+) thick. The head was not flanged over as is ordinarily done to fit inside the shell but was flat at the periphery and trimmed to the exact diameter of the shell; then the head was laid against the end of the shell, and even these contacting surfaces were not welded, as shown after the explosion, the welding consisting only of a skin which covered the visible joint on the outside. "The dishing of these heads was exceedingly unsatisfactory, in that it was too flat and also was not formed to a true and continuous curvature." There was a ⅞ in. through rod, not a bolt, fitted loosely in central holes in the heads, and the flush ends of the rods were welded over. A test of the safety valve after the explosion showed that it blowed at 95 lb., but whether this pressure was reached does not appear.



COMPRESSOR AND EXPLODED RECEIVER

The report of the Chief Boiler Inspector of the California Industrial Accident Commission says: "This is only one other instance of the unreliability of welding." We must protest that it is nothing of the kind. This



RECEIVER AND HEAD

was self evidently a shameful, a criminal, malapplication of the welding process, and true, honest welding was not on trial.

EXPERIENCE WITH A DENSE-AIR ICE MACHINE

BY C. H. WILLEY

In a country club where a three ton Allen dense air ice machine had been installed to supply cool drinking water, a daily supply of 350 pounds of ice and the cooling of the storage rooms, I was called to find out why the machine would not work properly. In spite of all efforts of the man in charge the machine would not build up sufficient pressure in the system. Upon asking questions the operator told me that about a month ago when they were giving the machine a general overhaul and had the expander piston out to smooth up some scores in it, that when they replaced it the machinist failed to tighten it securely in the cross head and it gradually worked out until it drove out the cylinder head and cracked the cylinder. A new cylinder was obtained and installed, but when the machine was started it would not even frost the pipes. After considerable hunting and puzzling the engineer decided that the expander valve was to blame and that by changing its setting he could make it run right. So he took out the valve and added on 3-16 of an inch to each end. Then he put it back and the machine seemed to do better for a while. Finally it got worse, and at this stage I was called.

I checked up the valve settings and immediately removed the built up valve and plugged the screw holes where he had added the pieces, then set the valves according to the maker's directions for a three ton machine which measurements for the expander cylinder are: Lower valve, 1-32nd of an inch lead; upper cut-off valve, closes or cuts off at 6¼ inches. With these settings and a properly designed valve obtained from the makers the machine would operate all right.

It seems so foolish to think that anyone would attempt to change a valve length or design, or for that matter, any other part of a machine which is designed and manufactured by experts, and especially so when one stops to realize that several thousands of these machines have been sold and are highly satisfactory. Many troubles could be avoided if operators of these dense air ice machines would give them the proper care and study out the principle of their operation so that they could more readily trace a trouble and hit upon the right solution. The writer who has given some thought to and for eight years has operated these machines, therefore hands on these pointers.

These machines when started up take the air from the atmosphere through what is known as the primer pump, and gradually build up the pressure in the system to five atmospheres, (60 to 70 lbs.). It is when the system is so charged at this pressure that it does its work of cooling. This is the pressure in the system. This air is then taken by the compressor cylinder and compressed to 210 to 240 lbs. (a ratio of 3 to 1 being about right between pressures). Compressing the air heats it. Heat that is stored up by the labor expended upon compression is partly removed by passing it through a copper cooling coil immersed in circulating water, which reduces the temperature to nearly that of the water. The air then passes into the valve chest of the expander which is in construction very much similar to the usual steam engine equipped with the riding cut-off valve. The valve admits the compressed air (210 to 240 lbs.) upon the piston of the expander cylinder to a certain point of the stroke and then cuts off. The piston continues to travel to the end of the stroke, the air exerting pressure upon it which constantly diminishes by expansion. This takes out of the air a quantity of heat equal to the labor performed by the air expanding. The result is a very low temperature at the end of the stroke. The return stroke pushes the cold air out into the system at a pressure of 60 or 70 pounds.

The expander helps the steam cylinder and the compressor takes the power. The expander cylinder cut-off valve must cut off the pressure at such a point that the expanded air at the end of the stroke of the piston is very nearly the same as the pressure in the system out into which it pushes it.

Many troubles can be avoided in the operation of the dense air machine if they are given the proper care. A few points on their operation that will help are given here.

Do not overtax the capacity of the machine. The amount of piping used in refrigerating the storage boxes of rooms should be such as to give about one square foot of outside surface of piping to three square feet of interior room surface (ceiling, sides, and floor, interior divisions not counted) for the rooms which the cold air enters first. For later rooms 2½ square feet, and when a very large amount of room is to be cooled the last room should have about one square foot of refrigerating surface for two square feet of interior room surface. It is best to have the cold air enter the room first near the ceiling, especially in the later rooms, so the air currents may ascend to near the ceiling. The rooms that are to have the advantage in being kept cold should have the cold air first.

The two most vital points, to be sure, are first, that your circulating water through your coil (and water jacket around the compressor cylinder) is properly circulating. An item in connection with this is to see that this piping through which the circulation water is drawn from the sea and delivered to the cooling coil is well lagged, especially if it has to come through warm compartments, such as boiler rooms over boilers. Next, that when for any reason work is being done on any part of the system or valve chests or cylinders, great care is given to keeping the interior free from air and grit. A small scratch or score on the face of the compressor valve will very vitally affect the proper work of the machine. These valve surfaces must be tight and a lubricator installed to give them an occasional drop of oil. The oil must be of ice machine class, able to stand heat and cold. A good mineral oil from which paraffin is removed by freezing is suitable. All joints should be very carefully made, as air leaks do not take up, but get worse in time. Once every three months a pressure of 60 to 70 pounds should be put on the pipes, and every part of every joint, and every bolt head should be carefully inspected and tested by putting on a lather of soap with a brush, so that any leak will be easily detected by formation of air bubbles. These leaks must be stopped in a permanent manner. Joints are generally made with thin rubber gaskets and the joint painted with litharge and glycerine. An occasional draining out of the bottom of the coils in the refrigerating room helps.

The whole piping system should once a year be steamed out and then blown out. The machine should run at an average of 50 to 150 revolutions according to the number of boxes or rooms being cooled or the volume of air being used.

All stuffing boxes on the machine piston rods should be well packed and kept tight. Be careful not to score the rods. Every tiny leak about the machine means loss of efficiency in refrigeration.

The piston leathers of the compressor and expander cylinders should last ordinarily about two months. They can be resoaked in castor oil and when swelled used over again. There should be a steel forming die (similar in construction to the piston in which the cup leathers are used), in which a spare set of leathers should be tightly clamped and formed. This die with the leathers in should be submerged in a can of castor oil. This treats the working edges of the leather to a soaking bath in the oil and keeps the main part of the leather that is clamped in the die or on the piston dry, the feature of this being that when the spare leathers are placed in use in the machine they will not require constant following up to squeeze out the oil and take up the slack.

The leathers should be made from oak-tanned leather slightly less than ⅛ inch in thickness and cut ⅝ inch to ¾ inch larger in diameter than the cylinders, according to size. When these leathers give out, trouble will be experienced with a loss of pressure. Sometimes the high pressure decreases in relation to the low, and sometimes just one cylinder may lose pressure and the system shows a loss of cold.

The clearance of the setting of the primer pump that makes up the air leaks is also a very important item. It should be the very least possible with regard to safety in striking. About 3-64-inch is right. The clearance in any of the cylinders of the air part is very small, so that very little change is permissible in the wearing parts and they must be very frequently checked up. When removing and replacing the nuts on the piston rods when putting in leathers, the unscrewing of the rod or the least movement of it in its cross-head must be guarded against. I think the change of these small clearances is the cause of the breakage of many cylinder heads that I hear of from time to time.—*Refrigeration.*

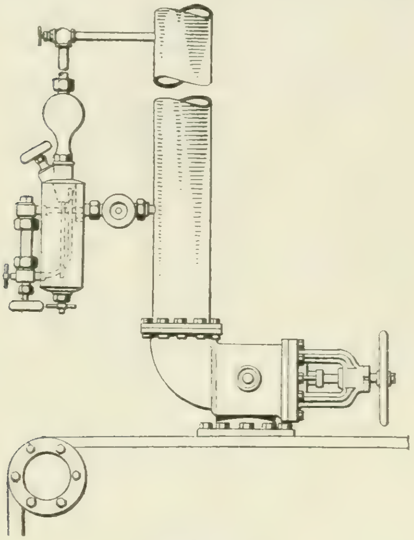


FIG. 1

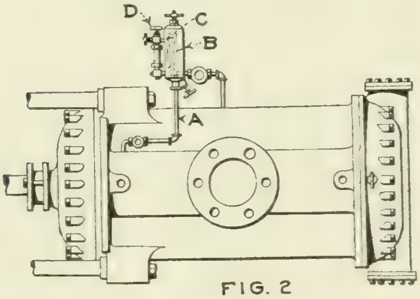


FIG. 2

SIGHT FEED LUBRICATOR ON COMPRESSOR

BY P. A. GETT

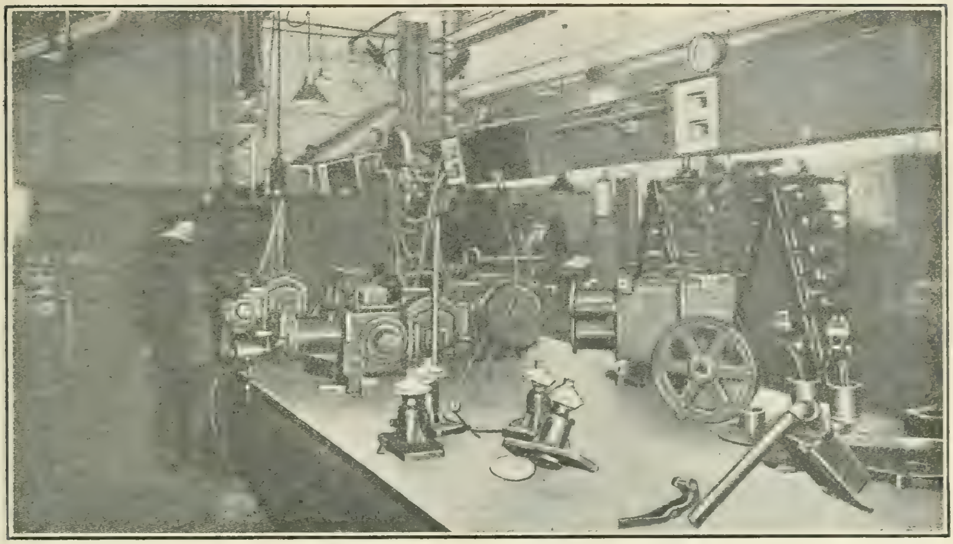
In moving a large air compressor, the lubricator was accidentally broken and damaged beyond repair. When the piston was taken out, the cylinder and piston were found to be badly scored owing to lack of oil, so it was probably a good thing that the lubricator broke, as either it had not been working properly or someone had neglected to keep it filled. An old hydrostatic lubricator was found about the place, and I set about to fix it over to use on the air cylinder.

Fig. 1 shows such a lubricator as it is connected up for use with steam, and Fig. 2 shows how it was rigged on the air cylinder. The condensing chamber was taken off and the lubricator turned upside down and a connection from the discharge side of the compressor hooked in where the condensing chamber had been. The feed connection was turned down and connected into the top of the cylinder at midstroke.

The action is as follows: The air pressure enters from the discharge manifold, through the pipe *A* and tube *B* to the top (originally the bottom) of the lubricator and forces the oil out through the tube *C*, needle valve *D*, and on through the sight-feed glass and discharge tube into the compressor cylinder. The operation is positive from the fact that there is always an unbalanced pressure between the two connections because the compression pressure has only risen to about half the discharge pressure when the piston passes the discharge connection of the lubricator at midstroke, and from this point to the end of the stroke there is suction on this connection and there is always discharge pressure on the other connection.—*Power.*

AIR SCREENS FOR FURNACE WORKERS

An account was recently given in a German technical paper of the latest methods employed in Germany for screening furnaces. Workers tending furnaces, and required to examine the glowing material at frequent intervals, suffered a great deal from the excessive heat radiated, and various devices have been tried to minimize the ill effects. For example, hollow water-cooled furnace doors have been tried, but obviously they afforded protection only while closed. Again, devices have been installed for drawing off the hot air in front of furnaces by centrifugal exhausters placed in front of the furnace opening. An objection to these is that workers are subjected to great variations in temperature prejudicial to health. According to the article quoted, the most effective device is to fix immediately behind the furnace door a narrow, oblong nozzle, through which cold air is blown upward, thus interposing a screen of relatively cool air between door and furnace. This arrangement is to give adequate protection to the worker, and has the incidental advantage when the doors of the furnace are opened the escape of flame is checked.



OVERHAULING BENCH

OVERHAULING AIR BRAKE COMPRESSORS

The term "overhauling" is used to include the removal of the compressor from the car, the dismantling of all parts, the cleaning and renewing of the parts as necessary, the replacing of all broken or excessively worn parts and their reassembling with proper lubrication.

Such an overhauling can be best and most quickly done on an overhauling bench specially constructed for convenience and thoroughness in carrying out the work. The compressor overhauling bench shown in the accompanying illustration, from *Electric Railway Journal,* is installed at the Southern Division inspection and overhauling shop of the Brooklyn Rapid Transit System. It consists of a zinc-covered platform 19 ft. long, 7 ft. wide and 25 in. high, with an open space on all sides. Such a bench will accommodate eight compressors, and all the auxiliary piping, electrical connections, storage reservoirs, etc., are arranged with eight units, so that the work of overhauling and testing on one compressor need not interfere with that being done on others.

Sixteen 14 in. by 18 in. reservoirs are installed under this bench. They are connected in series and piped in pairs so that each compressor can be used to charge two reservoirs. The air thus compressed in these tanks is used for various operations in the air brake room. At the center of each side of the bench is a tap for attaching a hose so that the air may be used for blowing out and cleaning the compressors being overhauled. At one end of the bench a connection is provided so that the air may also be used for testing and adjusting door engines, more than 7,000 of which are used on this property. At the other end of the bench there is a connection to the air hoist which is used for handling the compressor while it is being overhauled.

A bench for overhauling other air-brake parts extends along the wall at the side of the compressor bench, and the reservoirs also supply air to this bench. A board extends over the top of the compressor overhauling bench for supporting the various contact boxes, switch and fuse boxes, gages and governor used with the electrical connections to the compressors. This board is 11½ in. wide and is supported by a 1-in.-pipe framework 4 ft. above the top of the bench. The contact boxes have two contact fingers, one for the positive and the other for the negative side of the compressor connections. The boxes are made of asbestos lumber and are fireproof. At one end of the leads used for connecting to the compressors is a plug contact. This consists of a flat piece of hard rubber with copper plates on either side. By shoving this between the contact fingers in the box the electrical connections are made. At the other end one of the leads is provided with a knuckle joint connector for connecting to the compressor field and the other has a brass ferrule for insertion in the brushholder. These connections can be made very readily. Each individual testing circuit is protected by a 10-amp. fuse and a knife switch. A single governor regulates the cutting in and out of the compressors while being tested but each is provided with a separate air gage.

The bench is lighted with eight drop lights with shades. Extension cords are used where the light is needed closer to the work.

EFFECT OF PNEUMATIC TOOLS ON WORKMEN*

BY FRANCIS M. BARNES, JR., M. D.

Within the past two years complaints of ill effects from the use of the pneumatic hammer have become prevalent, although these do not seem to have originated so much with the individual user of the hammer as with labor organizations of which he is a member. It has been claimed that the use of the hammer produced in the men a diseased condition affecting the nervous system and leading even to paralysis, insanity or other form of complete incapacitation.

NO COMPLAINTS IN THE MEDICAL RECORDS

In view of the fact that in current medical literature no mention of such diseased condition from this causation could be found it became necessary to carry out an investigation to determine, if possible, whether such disease actually did exist, its extent and seriousness, and, if necessary, to study measures whereby its occurrence could be minimized or entirely done away with. Such a study is obviously of importance, not only to the workman, but to the operator whose interests are more broadly involved.

Recent investigations have been carried out in parts of the country where the pneumatic hammer is used in shipbuilding and in the steel industry. From reports of such investigations as are available it was not found, in any instance, that the use of the pneumatic hammer produced any deleterious effect upon the general health of the workers.

So far as this study is concerned the men using pneumatic hammers on limestone were found to be in good general health, none of the group examined showing any constitutional disease; their troubles (supposedly arising from use of the hammer) being limited to a disturbance of the function of the left hand—commonly known as "white fingers" or "dead fingers." As a general thing this condition occurs shortly after the men first go to work in the morning, or until they have "warmed up," although it also occurs during cold weather when the hands are exposed otherwise than in working.

First the little finger and that side of the left hand (in right-handed men) become pale and blanched; the same area soon giving rise to tingling or numbing sensations, sometimes even to slight pain. The ring finger and part of the middle finger may also be involved in this process. By swinging the arms or rubbing the hands the condition may be made to disappear and when the hands are warmed the pallor rapidly gives place to diffuse flushing and reddening. The index finger and thumb of the right hand are occasionally affected, particularly in those workers who improperly control the exhaust by their finger or thumb.

EFFECTS DUE ENTIRELY TO THE COLD

So far as could be determined this condition of the hands constitutes the sole trouble from which the stone workers complain in so far as the pneumatic hammer is concerned. In all of the workers examined the hands were somewhat reddened and flushed, but not more than reasonably might be expected in the hands of outdoor workers. The hands were calloused to a varying degree in different subjects, but in all quite extensively. The palm and certain of the fingers of the left hand were more calloused than on the right. There was no actual cyanosis, excepting in one subject, where this was slight. No swelling, no tenderness, no pain, no edema and no involvement of the muscles or joints. Paresthesia was absent excepting in one subject, who reported some numbness in his "white fingers." This was the only subject to show the condition well developed. Sensation for all tests was acute and practically normal. In most subjects there was a lowering of acuteness of feeling—some blunting or dulling—but this certainly was no greater than could be expected in hands where so much callous was present. In all but one subject the callous was sufficient explanation for any variation from the normal which could be observed in sensation. In this one subject the sensory disorder passed off in a few minutes or as soon as the hands became warm. Mental disease was not present in any subject examined, nor was there any physical disease which could in any way be attributed to the occupation.

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*Abstract from paper at Seventh Annual Congress of National Safety Council.

Such disorders of the extremities indicate quite clearly that a disturbance of the peripheral circulation of the blood is responsible for their occurence. The caliber of the peripheral blood vessels, and therefore the amount of blood supplied to the part, is dependent in large measure upon the action of the nerves which supply these blood vessels, known as vaso-motor nerves. Low temperatures stimulate the sensory nerve fibers in the skin and the nerve impulses thus aroused reflexly stimulate the vaso-constrictor center, or a part of it, and cause blanching of the skin. That cold may produce evident changes in the appearance of certain parts of the body, notably of the extremities—the feet, hands, ears and nose—is a matter of common observation.

It has been pointed out that exposure of the hands to cold usually produces at first a pallor of the skin which is evidently due to a constriction of the cutaneous arterioles. When the exposure is prolonged, however, the color is heightened and the skin usually becomes more or less cyanotic. Almost universally, therefore, cold produces a constriction of the cutaneous arterioles and a slow flow of blood through the skin. The variations in color are thus caused by the varying amounts of blood that collect in the skin capillaries. The flow through the blood vessels is also in part influenced by the muscles which surround them. Anything, therefore, which interferes with or impedes the normal action of the muscles will have its effect in turn upon the circulation, as it is the changing state of contraction and relaxation of the muscles which aids in the flow of blood under normal conditions. Where a group of muscles is held in a contracted state for a considerable length of time the circulation is thereby impeded.

With the workman, whether using a chisel and mallet or a pneumatic hammer, the factors of cold, continued muscle contraction and cutaneous irritation are all present to a considerable degree, and demand due evaluation in the consideration of such disorders in the hands as are sometimes observed. The fact, borne out with uniformity in this investigation, that the trouble occurs only in cold weather indicates most conclusively that the low temperature itself is one of the most important factors in the causation. The continued muscular contraction and the mechanical irritation (vibration) may play a role in its causation, but evidently these are of secondary importance.

THE HAMMER HAND NOT AFFECTED

The fact that the trouble, when present, preeminently affects the left hand, which holds the chisel and not the hammer, indicates clearly that other factors than the hammer itself are more signal importance in its causation. The cramped position of the chisel hand with the more or less continuously maintained contraction of the muscles is one of these important factors. However, the hammer or the grip of the chisel, either alone or combined, are not sufficient to produce the condition, as is proved by the fact that it does not occur in the warmer seasons of the year when industry is at its height. The role of the vibration is uncertain, but as the trouble occurs in the hand not holding the hammer, it is doubtful if this factor is of much importance. We have left, therefore, the factor of low temperature which seems to be the final and most important element in the production of those vascular changes seen in the hands of some workers which, although physiological in nature, form the pathological basis for the occurrence of "white fingers" and "dead fingers." So far as can be ascertained the condition leads to no permanent disability and results in no organic disease. Why it is that only a portion of stone cutters are affected cannot be answered. Whether certain undetermined conditions of poor general health or specific diseased condition existing, but not recognized, predisposes certain men to this disturbance is not evident from this investigation, although apparently such is not the case. With one or two exceptions they were all well developed, robust men without demonstrable general physical or mental disease.

SOME OF THE CONCLUSIONS

Structural steel workers, shipbuilders and stone cutters as a class, enjoy good general health and are not, because of their trade, especially susceptible to any particular disease.

Stone cutters are liable to a disorder affecting the hands, especially the left hand. This disorder of the hands is of a vascular character, not due to organic changes in the circulatory system, but dependent upon vaso-motor reactions. These reactions are physiological in character and are occasioned by three factors incident to the work of stone cutting: Mechanical irritation of the skin, continued muscular contraction of a cramping nature and low temperature. Of these three factors, cold is considered the most important because the condition only occurs during the severely cold weather and never in the summer, and warmth and measures to restore the circulation (rubbing, swinging the arms and the like) cause its disappearance.

It cannot be caused by the effect of the air hammer alone because it occurs in those who have not used the air hammer. It does not occur in warm weather when industry is at its height and, therefore, when the air hammer is most in use. It occurs mostly in the left hand and not in the right hand in which the hammer is held.

The institution of measures to warm the chisel before and while using, enlarging the shank of the chisel and covering it to make it possible to hold without so cramping a grip, the wearing of gloves, and the discontinuance of the prevalent custom of blocking the exhaust outlet, and thus forcing a draft of chilled air out along the chisel and onto the fingers of the left hand would do much toward the prevention of this trouble.

TEMPERING DRILL STEELS FOR JACKHAMERS*

Many thousands of pounds are being spent by the mining groups on jackhamers. Consulting engineers and mine managers are studying the question as to which is the best machine on the market, etc. In my opinion, greater attention should be given to the tempering, sharpening and shanking of the drill steels. A few days ago I watched the Kafir drill sharpeners at work on a mine where the officials are endeavouring to make the jackhamer a success. The drills were being sharpened at a rapid rate, but the natives were absolutely ignorant of the method of tempering or hardening the bits or cutting edges. They have no knowledge whatever of the colour of the heat required to harden the drills. These were plunged into the water at a yellow to a dull red heat and several times at almost black heat! How can jackhamers be a success when such steels are used? I examined a number of shanks and found the striking end on some broken and not square; this is fatal to pistons. The wonder is that jackhamers do as well as they do under such conditions. The best method of tempering drill steels that I have seen on these fields is at the Brakpan Mines, where the steels are re-heated for tempering by two natives and handed to a third who plunges them when the requisite heat colour is obtained. A study of this method is well worth the consideration of other mines. Considerable saving would be effected by the appointment by each group of a qualified "Steel Temperer and Drill Sharpener" to inspect this work. The amount of steel used would be considerably lessened, the cost of upkeep of the rock drills would be less, and the number of holes drilled per machine per shift would be increased.

AMERICAN WELDING SOCIETY TO BE FORMED

A new association, to be known as the American Welding Society is being formed through a merging of the Welding Committee of the Emergency Fleet Corporation and the National Welding Council. Other men interested in the application of welding to shipbuilding, and, in fact, to all manufacturing processes, are also included in the new society.

Scientific societies and experts in all the welding fields will be brought together to aid in the maintenance of a Bureau of Welding, which will be a separate organization, designed to carry on research and aid in the standardization of welding as a process.

The organization, through its dues, will provide funds for research, will superintend the carrying on of research, advance and training of expert welders, and serve as a medium to accomplish advantageous legislation and suitable publicity for the work.

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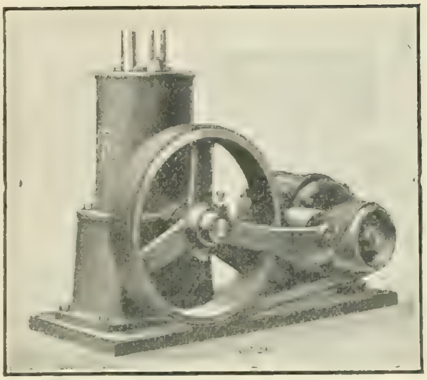
*Correspondence *South African Mining Journal.*

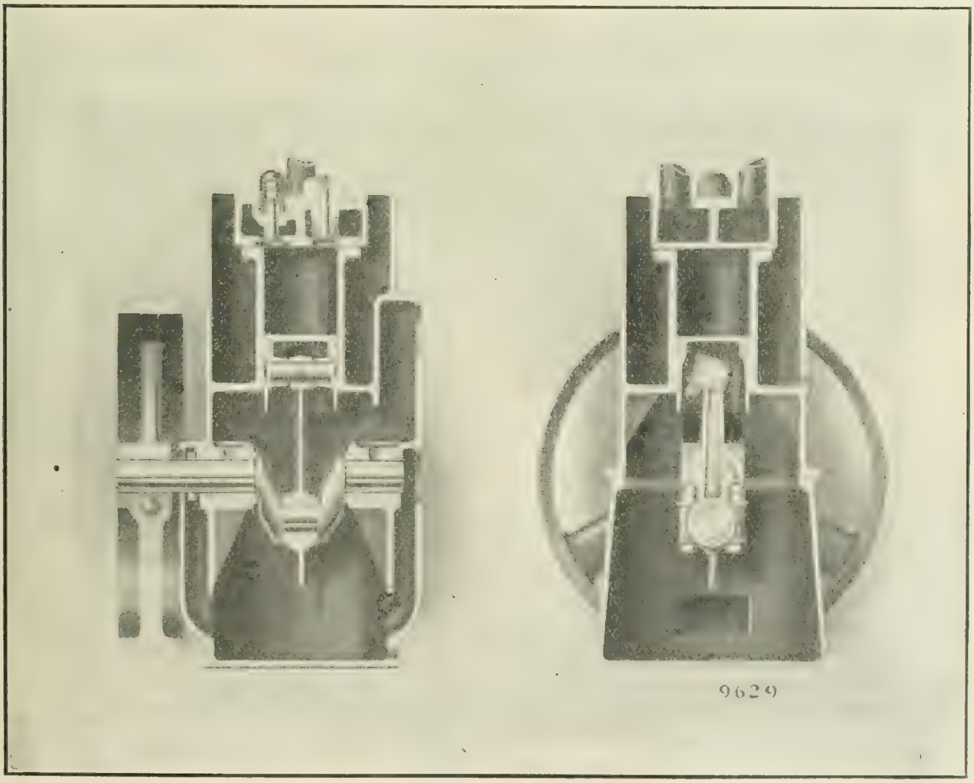
A LITTLE WAR COMPRESSOR NOW READY FOR ANY JOB

When, in the emergency at the outbreak of the war, there was a sudden call for a large number of small air compressors for service where reliability was imperative, the Ingersoll-Rand Company's offer, to produce for immediate use the Imperial Fourteen Compressors which it had just completed testing out and had adopted as the new standard small compressor type, was accepted. The field performance of these built-on-hurry-order machines was watched with critical eye, but after a year's service their record was clear. They had proven themselves efficient, reliable, and inexpensive to operate.



LITTLE WAR COMPRESSOR

Now these little machines have been placed on the general market. There are four sizes and the capacity range runs from 3 to 45 cubic feet per minute at pressures up to 100 lbs. per sq. inch. The small compressors can, however, be used for pressure requirements up to 200 lbs., the horsepower needed being, of course, slightly increased. They are single acting machines of the vertical type built for belt drive. Where driven from line shaft, tight and loose pulleys are supplied; where the use of independent motor is planned they are ordinarily furnished as a unit complete with motor, endless belt and short drive at-



VERTICAL SECTIONS OF COMPRESSOR

tachment. In the latter case a hardwood base plate is included with the standard equipments.

The machines are so well balanced as to operate satisfactorily if bolted to any solid flooring, but where permanecy of installation is desired the building of a concrete foundation is advocated. The smallest size is built with ribbed cylinder for air cooling where the service is intermittent and with water cooled cylinder of the reservoir type for continuous operation. Larger machines are water cooled only, employing the reservoir jacket system except that, in the case of the largest size, a closed jacket for connection to pressure system is optional. In this connection it is worth noting that the reservoir cylinder design affords unusually ample water capacity and that both cylinder barrel and head are cooled. The manufacturer states that a single filling of the water space will suffice for a 10 hour day's run.

In general design the Imperial Fourteen Compressors remind one strongly of an automobile engine. There is the same drop forged crank shaft and connecting rod, the die-cast renewable bearings, the automatic splash lubrication system and general ruggedness and simplicity which have come to be recognized as guarantees of satisfactory service under all sorts of operating conditions.

It is pointed out, however that these little units were designed to meet exacting efficiency test and that, while simplicity was sought, efficiency was the insistent requirement.

VENTILATION METHODS IN COEUR D'ALENE MINES*

BY ROBERT N. BELL

The metal mines of this State (Idaho) are mostly in high mountain regions. Those of the Coeur d'Alene have their vein outcrops on the mountain-sides, and are developed by adit or cross-cut tunnels to depths varying down to over 2,000 ft. This gives ample natural gravity air-pressure circulation that usually affords good ventilation and is easily controlled. The natural advantages of this region in this respect and its deep sedimentary formations are exceptional, but in recent years, in three particular cases, the ore penetration has been developed extensively below the lowest points of surface-drainage entry, involving cross-cut tunnels, three of which are two miles long. In these cases the tunnels are of a minimum size of 7 by 8 ft., and are used for drainage, haulage, and ventilation. They are costly openings to drive, and owing to the uncertainty of results to be found a double-entry tunnel was never warranted as it is in coal mine development, and the further fact that return outlets are invariably provided at high elevations for air circulation.

Above these deep drainage-levels, ventilation by natural gravity air-currents was a simple matter; but each of these mines, and several others in lesser degree, have shown persistence in their orebodies to great depth below these lowest drainage-entries, and the sub-levels thus developed have rapidly expanded in the past few years. This involves a new problem in ventilation, where the long tunnel is depended upon for the main air supply, by reason of the fact that the long electric ore-trains running in these air-courses act as a part piston and resistance when in motion against the air, and materially retard its flow. Sub-level ventilation by natural gravity air, even with these deep drainage advantages and numerous higher outlets, has lately proved inadequate in volume and velocity to fully supply the normal working requirements of the men, and must be assisted by mechanical means. A ventilating system that will simply carry away the smoke and gases from blasting and emanations from men and lights, is a mistaken economy in big mine operation, as the great harm resulting from an insufficient supply of good air is markedly shown in the behavior of the men employed in such a mine. Surliness, discontent, inefficiency, and a general desire to cut work or sojer are often directly traceable to poor air, and there is no investment that will pay a bigger return in resulting efficiency of the workers than good ventilation.

The long tunnels of the Morning and Bunker Hill & Sullivan mines, due to the natural wall resistance and moving trains, are incapable of carrying sufficient air to properly ventilate their extensive and rapidly deepening sub-levels without mechanical induction. Fortunately, both have several other outlets in addition to their long tunnels which, while at a much higher level, can be used and are used as additional sources of fresh air, with the return or up-cast directed through still other outlets. These matters have been under discussion for the past four years with the State Mines Department, and the managements of those mines have been entirely willing and anxious to improve their ventilating conditions. To do so, however, in addition to mechanical installations, it involves the driving of several thousand feet of expensive straight-line raise connections, but as labor has been so scarce this work has been decidedly retarded.

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*Abstract from report of State Inspector of Mines for 1918.

In this connection, as men have been available, over 900 ft. of big raises have been driven at the west end of the Bunker Hill mine and are now being extended, to be used exclusively as an air-course, and during my visit to the property in December, a large station was being cut for a recently ordered 60,000-cu. ft. Sirocco fan. This is to take fresh air not only from the Kellogg tunnel, but also from the adjacent Sweeney shaft and other west end outlets, affording an ample supply for all purposes, when mechanically driven and controlled, to the deepest point of the mine with the necessary air-doors and stoppings. Present plans contemplate, if it is found necessary, the installation of another large Sirocco fan near the head of the No. 2 East shaft, which is a natural up-cast, and will afford a permanent circuit through the East end outlets, above the Kellogg tunnel. This is the deepest mine in actual ground penetration in the plane of the vein in the Coeur d'Alene. Its orebodies are entirely in quartzite formation. They vary in size up to 100 ft. in horizontal cross-section and 900 ft. in length. The mined spaces are uniformly timbered with square-sets and closely filled with waste. The levels are 200 ft. apart vertically and 300 ft. on the dip of the vein, which is 40 degrees. The hottest place in the mine is 1500 ft. above the bottom level at the apex of the Cameron stope at the No. 10 level cross-cut connection. This is one of the largest stopes in the mine that has been actively operated for the past 12 years. At this point the temperature is 80 degrees. The humidity reaches dew-point, and is largely due to local faulting, the friction of slowly packing fill, oxidizing timbers of the big stope, and the fact that it is a converging point of return air.

The highest bottom level temperature in the mine at the new 15th level, which is 4800 ft. on the dip of the vein below its highest crest, and 3400 ft. vertically under the mountain, registered only 70 degrees F. This point is 5400 ft. in the pitch of the main ore-channel below discovery cut. The top of the big stopes at No. 13 and 14 levels registered 75 degrees, and the No. 2 shaft-station main return air-course at the 13th level, 70 degrees.

These are comparatively low temperatures for such depths. The mine, however, is damp throughout and the relative humidity is high in all these sub-levels, causing men to perspire freely at work, this giving the impression of much higher temperatures than actually prevails. The only remedy for this humid condition is a greater volume and velocity of fresh air-currents, and the company is making an earnest effort to attain this improved condition, which, I think, will shortly be accomplished.

At the Hercules mine, with a drainage cross-cut tunnel at its lowest point from Canyon creek only a few hundred feet short of two miles in length, the natural ventilation in its new sub-levels is still good. Its new vertical four-compartment shaft from this level is 1400 ft. deep, but only three sub-levels have yet been opened down to the 600-ft. level. The large underground hoisting-stations are completely sealed with tight-air doors. The main shaft in the winter carried 30,000 cu. ft. of fresh air in December, affording ample ventilation for the present levels, by way of the shaft, drifts, stopes, and up-cast through several large rock raises to the No. 4 tunnel outlet, 600 ft. above No. 5, a natural return-circuit in the summer. Stations are now being cut in the new shaft at the 800 and 1000-ft. sub-levels in this mine, where the natural temperatures are slightly under 70 degrees and well ventilated by an exhaust fan at the 600-ft. station.

The Hecla mine has a natural advantage in ventilation from the fact that its main working shaft starts at the surface, and does not involve the long adit approaches of the other mines mentioned. It is ideally situated for natural gravity-air ventilation, and the management has taken full advantage of this condition. This mine has a drainage-level on the course of its ore-zone several thousand feet, striking directly into the east side of the abrupt slope of Canyon creek, near the main surface shaft-collar. The main shaft now has a maximum depth to its new bottom station of 2,000 ft. vertical. The bottom working-level is at 1600 ft., and the lineal distribution of the orebodies are strung out through fully 3,000 ft., and duplicated with several parallel shoots of ore with many raises, chutes, and manways at short intervals.

Near the east end of the ore development an expensive straight-line raise, nearly vertical and 1400 ft. high, was put through to the surface from the drainage-tunnel for ventilation purposes. It gives a maximum gravity vertical range to the 1600-ft. level through connecting raises for natural air pressure of 3,000 ft., with several other outlets above the drainage-tunnel to relieve the main west stopes. This theoretically presents almost ideal conditions for natural-gravity air circulation.

The main shaft has a large-size idle compartment, and each station drift-entry is provided with an air-door. In December this shaft, acting as a natural down-cast, was distributing 28,000 cu. ft. of fresh air per minute at high velocity through the lower levels, with return through numerous outlets to the surface. The recent rapid expansion and duplication of the operating openings and oreshoots of this mine, all heavily timbered, develops a heavy resistance to free air circulation, in spite of its extremely high chimney-draft value. It also retards the flow of the return air, which is believed to be due, in part, to lack of proper splits in the west orebody, a condition that the company's engineers are now studying carefully with a view to remedy by additional doors and stoppings. If this is not effective, a powerful Sirocco fan will be put in as an exhaust, probably at the head of the No. 3 tunnel, 1400-ft. raise.

The temperature at the new 2000-ft. station in this mine in December was 70 degrees, with relatively high humidity. Like all the other sub-level mines, the maximum or warmest place tested in this one, due to the same cause of temperature localization as the Bunker Hill & Sullivan and Morning mines, was at the top of an exhausted stope on the 600-ft. level, 1,000 feet above the bottom working-level, which gave a reading of 70 degrees.

GET A BLASTING EXPERT

In the actual loading, tamping and wiring of charges in drill holes there is little variation of method, and relatively little labor is involved; hence no appreciable amount of labor can be saved by modifying the mechanical processes connected with blasting.

However, efficiency in blasting has a direct bearing on the amount of labor required subsequently. Improper arrangement of drill holes, imperfect balancing of charges, or the use of too strong or to weak an explosive, may result in a very inefficient blast, and, as a consequence, the loading of rock may be greatly hampered. In fact there is no other department of the quarry in which inexperience or lack of judgment may in a brief period occasion more disastrous consequences.

This is particularly true where many large blasts are fired simultaneously in deep churn-drill holes, for the mass of rock thrown down may occupy the rock loaders for a period of several weeks or even months. If the rock is imperfectly shattered, or improperly thrown down, excessive secondary blasting may be required, and the loading may be slow and difficult throughout the entire period. Hence, it is false economy, both of money and labor, to employ inexperienced men as blasting foremen.

A realization of these facts has led some operators to engage the services of blasting experts, who are not permanent members of any quarry organization but travel from quarry to quarry as their services are desired. Such an expert, in accordance with the judgment gained by long experience, supervises the arrangement and spacing of drill holes, selects the explosive, proportions the charge for each hole, carefully inspects or tests all connections, and fires the charge. The efficiency of the results usually obtained amply justified the employment of such experts.

If, on the other hand, blasting is done by an experienced man of good judgment, the subsequent operations may be greatly simplified. If the rock is thoroughly shattered, little labor is required for secondary blasting, and if the rock fragments are thrown down in a way that permits easy handling, loading may be done rapidly and with minimum effort.
—*Pit and Quarry.*

IS COMPRESSED AIR USED ENOUGH ON CONSTRUCTION WORK?

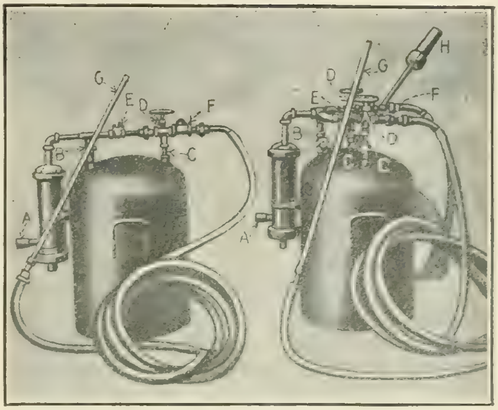
Although electric power is ideal where rotary motion is produced, it is not very satisfactory where reciprocating motion is desired. Thus, for drilling, tamping and the like, compressed air or steam is preferable to electricity. Compressed air is also suitable for use in driving rotary tools or machines, such as augers, hoisting drums, etc. Hence there is a very wide field of usefulness for compressed air, a wider field than is generally realized by construction engineers and contractors.

Portable compression plants driven by gasoline engines are already used extensively, but for every one now in use there should be a score or more. There is rarely a large construction job on which a portable compressor would not prove profitable. To enumerate only a few of the uses of such a plant will serve to indicate its general applicability. Thus, there is: Ramming or tamping of concrete, earth backfill, ballast, etc.; drilling with hammer drills, piston drills and rotary earth augers; boring wood for bolts and driftbolts; hammering drift bolts and spikes; adzing and dropping timber; cutting pipe threads; toothing out paving brick and chipping the mortar from old brick; operating small hoists, swinging derrick booms, etc.; riveting; operating grindstones, small saws, etc.; pneumatic painting and sandblast cleaning.

With wages 50 to 100 per cent. higher than they were five years ago, there is greater need than ever to use labor saving machines and devices. Compressed air tools furnish an admirable means of reducing labor costs on construction work—*Engineering and Contracting.*

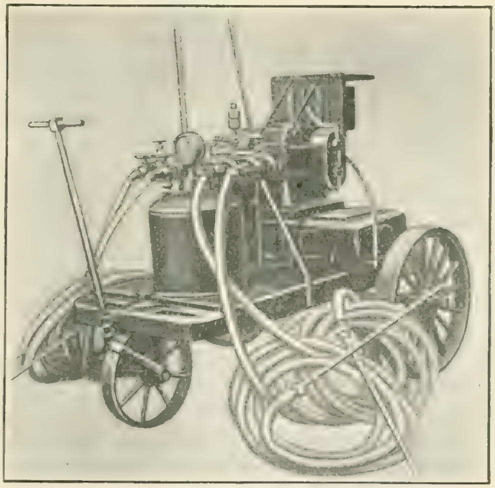
PREHEATERS FOR WELDING OPERATIONS

As practically all ordinary welds, except those on pipe, require preheating it is well wherever possible to use heaters made for the purpose. We show here preheaters made by the Metal and Thermit Corporation designed to make the preheating work as easy and convenient as possible. In Fig. 1 are shown a single and a double burner. For small jobs the single burner, which may be fitted with a flaming burner also, will probably answer the purpose. Where a number of welds are to be made, however, the double-burner apparatus should be selected. In these illustrations *A* is the place to attach the hose from the compressed-air supply; *B* is the valve for regulating the pressure on the surface of the fuel; *C* is a tube which runs within a few inches of the bottom of the tank; *D* is the needle valve which controls the fuel to the burner; *E* is the air pressure control to the burner; *F* is a check valve which prevents back fire; *G* are torches or burner pipes; *H* is a flaming burner. The small tank on the left side is a water separator for the compressed-air supply.



TWO PREHEATERS

Fig. 2 shows a four-burner portable apparatus used largely for rail-welding work. It carries its own air compressor, which may be run by attaching to a trolley wire or to some other electric-current supply. All of these burners use either gasoline or kerosene.



PORTABLE PREHEATER

Symbol	Specific Gravity Baume	Flash Point Deg. F.	Fire Point Deg. F.	Cold Test Deg. F.	Viscosity Saybolt Sec.
A	26.5	500	560	55	115 at 212 deg.
B	29.5	440	490	35	385 at 100 "
C	31	400	450	20	180 at 100 "

LUBRICANTS FOR AIR COMPRESSORS

The little table here reproduced is taken from an extensive article on Lubricants for the Power Plant in *Power Plant Engineering*, April 15, by Reginald Trautschold.

In connection with the table it is remarked that the dry heat encountered in air compressor service necessitates the use of only particularly stable lubricants. Oil A is a very heavy, filtered straight mineral oil. It is unusually free flowing for such a heavy oil and is intended for service where the temperature in the cylinders is above normal (325 deg. F.). Such temperature is common in many single-stage compressors, particularly after the equipment has been in service some time, and for such units an oil of the grade of A should invariably be used. Oil B is also a filtered oil, intended for use in multistage compressors where the temperature is high. It is also an excellent lubricant for new well-cooled single-stage machines. Oil C is of medium viscosity and is intended for well-cared for multi-stage machines that are tight.

EXHALED AIR AND DIFFUSED BODY HEAT

The following table gives the composition of pure air and of respired air:

	PURE AIR	RESPIRED AIR
Oxygen.	20.35	16.2
Nitrogen.	78 10	75.4
Carbon Dioxide.	0.30 to 0.04	3 4
Water Vapor.	1.5 (variable)	5.

As the respired air is immediately diffused in the air of the room, it cannot be directly removed, but only diluted till it ceases to be harmful. There is, therefore, no definite standard of purity, and any line drawn between good and poor ventilation is arbitrary. Pure air contains 3 to 4 parts of carbon dioxide in 10,000. With an increase to 11 parts in 10,000, the air becomes noticeably oppressive, while an increase of 3 parts or a total of 6 to 7 parts is scarcely noticeable.

We have first of all to consider the heat generated by the human body, and the method of its disposal, which are important conditions determining the most desirable room temperatures, and in densely peopled buildings, largely determining the result of vital processes dependent in part upon the activity of the individual.

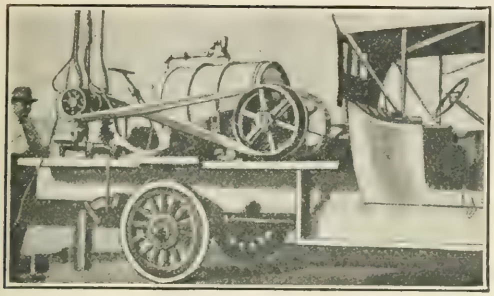
The following shows the amount of bodily heat diffused:

	B.T.U. PER HOUR
Child six years old.	240
Adult at rest.	380
Adult at work.	500
Man 30 years old in an atmosphere with a temperature 68° F.	440
The same in atmosphere of 31° F.	600
Woman 32 years old.	480
Adult in old age.	360

The amount of heat in B. T. U. usually assumed as given off per person per hour in an atmosphere of 70 degrees F. is 400 for adults and 200 for children. These are the figures generally used when the heating effect of the occupants of assembly halls or auditoriums is taken into account.—*Heating & Ventilating Magazine.*

AIRPLANE DEVELOPMENT

The following statement of the National Advisory Committee for Aeronautics shows the development in airplanes which has been made since 1903. The first man-carrying airplane flights were made in December, 1903, with the Wright Bros. engine, developing 12 horsepower and weighing 152 pounds, or 12.7 pounds per horsepower. In 1910, the average horsepower for aeronautic engines had increased to 54, and the weight had decreased to 5.7 pounds per horsepower. After another seven years, in 1917, the average power output had advanced to 243 horsepower, and the weight had decreased to 2.8 pounds per horsepower. In March, 1918, the Liberty motor developed 432 horsepower for a weight of 808 pounds, or 1.86 pound per horsepower. At present, the Liberty motor is developing a maximum of 450 horsepower for a weight of 825 pounds, or 1.83 pound per horsepower. The average consumption of fuel decreased from about 0.8 pound per horsepower in 1903 to 0.55 pound in 1918, and for the Liberty engine to 0.50 pound. The present consumption is about 0.46 pound per horsepower.

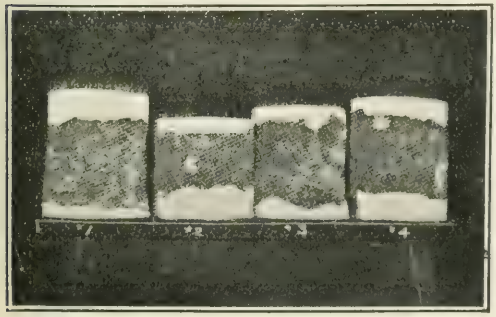


PORTABLE DRILLING RIG

CORE DRILLING OUTFIT FOR PAVEMENT SPECIMENS

A Calyx core drilling outfit mounted on a light motor truck is employed by the testing division of the California Highway Commission for securing test samples from finished pavements. With this outfit a 4½-in. cylinder is cut from the pavement, furnishing very satisfactory specimens for compression tests.

The drilling power is furnished by a 3-h.p. gasoline motor; the steel core cuts by grinding on the steel shot. Where the coarse aggregate of the concrete pavement is extremely hard and tough, the drilling takes from 30 to 40 minutes. The average concrete pavement can be drilled in from 6 to 15 minutes. The drilling of concrete pavement 5 or 6 years old made with gravel which consists largely of indurated sandstone required from 6½ to 10 minutes. Samples made of broken rock from a chert quarry were bored in from 10 to 12 minutes. Concrete made from boulders of extremely hard andesite required from 30 to 40 minutes. The actual time required for boring will be somewhat of an indication of the wear resisting qualities of the pavement. The borings taken from the pavement are valuable also in furnishing an exact record of the thickness and, also, in showing how thoroughly the concrete was mixed at the time of laying.



SECTIONS OF PAVEMENT

Tests by the laboratory of the finished pavement made with a 1:2½:5 mix at the end of 3 or 4 years indicates a total compressive strength in excess of 3,000 lb. per square inch.

The holes made in the pavement after the removal of the core are about 5½ in. in diameter and are usually repaired with neat cement and broken rock. When this mix is used, the cement sets up and gains sufficient strength in a few hours to make unnecessary any careful plan of protecting or curing the repaired holes.

PNEUMATIC RIVET CUTTER

The "Red Devil" rivet cutter here shown in actual use is manufactured by the Rice Manufacturing Company, Indianapolis. It is intended for removing defective rivets in connection with structural steel erection or repair work, as well as for cutting apart old structural steel that is to be saved for reerection at some other point. This rivet cutter is said to cut a 1¼-in. rivet in 10 sec. and to dispose of ⅞-in. and 1-in. rivets with from three to five blows.

The mechanical features of the device are simple. It consists essentially of a cold drawn, seamless tube about 5 ft. long with suitable fittings hydraulically pressed onto it at either end. The rear end is fitted with a valve by means of which air may be admitted into the rear end of the tube, while it is permitted to exhaust from the forward end of the tube through a rubber tube by-pass, or, by giving the valve a quarter turn, the air may be admitted through the by-pass to the forward end of the tube and exhausted from the rear end. The forward end of the tube is equipped with a bushing designed to give a good fit for a chisel bit. The interior of the tube is occupied by a plunger ground to fit the tube with just enough clearance to enable it to slip readily from end to end, yet allowing a minimum of air leakage.

As shown in the photograph, three men are required to operate the cutter. One stands at the forward end to guide the bit while two carry the rear ends by means of suitable handles, one of them manipulating the valve lever. By replacing the valve in position to admit air to the rear of the tube, the plunger is driven swiftly against the chisel; then if the lever is given a quarter turn, air admitted through the by-pass returns the plunger to the rear end of the tube, while the air behind the plunger escapes through an open port. After a little practice the workman can operate the rivet cutter either fast or slow or strike heavy or light blows. This enables him to give a light blow when the rivet is almost cut off to prevent the head from flying. Springs in each end of the tube absorb all the shock of the plunger other than that given to the chisel, so it is not difficult to hold the device when in use. The rivet cutter weighs 65 lb. in an operating condition and has a total length of 58 in. Under average conditions three men operating the tool are said to cut from 25 to 33 times as many rivets as they could cut in the same time by hand.

THE STIMULUS OF PIECE WORK

A New England manufacturer has in his factory a piece-work proposition on which the men employed earned on an average about $3 per day. The war reduced the force and the employer found it increasingly difficult and ultimately impossible to obtain a sufficient supply of men. Women have now been satisfactorily trained to do this class of work in the plant. Their diligence has made that $3 job worth $5 a piece to them every day. A visitor to the factory recently observed that according to the record of the operations performed now and formerly, three women were equal to five men! Even more interesting is the speculation as to what will be said should the men come back for their old places. And if they get them, what then?—*Iron Age.*

SELF-STARTER OF THE LIBERTY ENGINE

The Liberty self-starter is an air motor and compressor in one. While acting as a starter it runs as a four-cylinder air motor, cranking the airplane engine through a train of gears, inclosed within its transmission. At the end of the transmission is a final drive that connects direct to the crankshaft of the engine. This drive runs continually at engine speed and operates a small pump which furnishes pressure for the petrol feed. After starting the engine the Liberty starter automatically disengages and remains so until needed for further use, either as a starter or compressor. In order to keep an adequate air supply in the tank the starter is engaged as a compressor by pushing a button on the control valve while the airplane engine is running at low speed. When engaged the engine must be speeded up to 1,200 to 1,400 revolutions per minute. At 230 pounds pressure the compressor automatically disengages. The Liberty starter is light, weighing but 30 pounds. It is compact, measuring but eight inches long. It is efficient, cranking the engine at 150 revolutions per minute or more and replenishing its own energy in 30 second. It is simple, as there are no pipes leading to the airplane engine, so that it leaves the airplane engine as it should be. The tank weighs 12¼ pounds, making the complete outfit 42¼ pounds.—*Scientific American.*

MINERS EFFECTIVE IN THE WAR

We have frequently referred to the tunnelling work done by the Royal Engineers, aided specially by their Cornish contingent. Sir Douglas Haig thus refers to their labours in his despatch, of which we published a rather full synopsis last week: "The work of the tunnelling companies (he writes) has demanded, equally with that of the field companies, great courage and skill. In the period from August 8 to the termination of hostilities nearly 14,000 German mines and traps of various descriptions, totalling over 540 tons of explosives, had been discovered and rendered harmless by the different tunnelling companies, while a further amount of nearly 300 tons of explosives had been withdrawn from our own demolition charges and minefields."—*Mining and Engineering World,* London.

COMPRESSED AIR
MAGAZINE

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FINISHING TOUCHES FOR NEW YORK

The necessary legislation having been accomplished and the money provided for, it is now assured that the vehicular tunnel under the North River to connect Jersey City with Manhattan will be commenced without delay and, thanks to compressed air, we know that the job will not take long. The undertaking has its special features of difficulty, chiefly, as far as can be anticipated, in the unprecedented diameter of the perforation, and the imperative conditions of ventilation, which must be fully operative immediately that the tunnel is put into service and maintained without a minute of cessation forever thereafter. This in itself is one of the most serious and exacting of engineering problems, but no one entertains a doubt as to a satisfactory solution.

In the meantime additional plans to provide for the growth and maintenance of the great city and to make it more convenient and desirable for the large transaction of business and for the improving and perfecting of the detail requirements for residence and recreation are continuing to be developed, and no one has any clear idea of what New York will be or how it will look when it is finished.

Immediately following this tunnel there will undoubtedly be others following close upon it, probably another of similar character and purpose with this and located some distance from it up or down the river. A tunnel to Staten Island also is among the inevitables and additional tunnels or subways traversing Manhattan both for passenger traffic and for freight distribution.

As to improvements of different character which are constantly suggesting themselves, both desirable and eminently feasible, there is practically no limit. One immediately in sight must soon become an urgent necessity, not only for New York, but for every large city, and that is a suitable area for the taking-off and especially for the alighting of the ships of the air.

In our next suggestion for municipal improvement it is difficult to assign any pneumatic interest. The horse must be abolished from our streets and it is high time to begin to talk about it. He is becoming now a great interferer with local traffic instead of a help to it, and he is the principal distributor of filth in all our thoroughfares.

In connection with the horse nuisance the influence of compressed air cannot be invoked either pro or con, but the air compressor stands ready to be the principal agent in the abolition of another most undoubtedly objectionable and most surprisingly tolerated intruder. The air compressor is employed in large units and in great numbers for the compression of natural gas to facilitate transmission. The gas so transmitted is also distributed at high pressure everywhere, and no one apparently has ever even thought of using the unsightly gas holders for the service. If they can be entirely dispensed with in natural gas service, how can they be indispensable for artificial gas?

LIQUID AIR DEVELOPMENTS

The following is abstracted from a recent lecture by Sir James Dewar before the Royal Institution. He first of all traced some of the practical effects that have resulted from low temperature research. The final stage was Haber's discovery that when a mixture of hydrogen and nitrogen is passed over a catalytic agent (osmium was used first, and finally finely divided iron) at a high pressure of 200 to 250 atmospheres, and a temperature rather below red heat, the issuing stream of gas contains a proportion of ammonia, which can be obtained in a constant supply by absorption in water or by freezing with the aid of low temperatures. The nitrogen required was available in abundance, and pure hydrogen, was obtained by freeing water gas from impurities, again by the aid of low temperature. The oxidation of this ammonia yields nitric acid, a substance that is indispensable for the manufacture of modern high explosives. The importance attached by Germany to this process is indicated by the fact that it was made a State monopoly. In Germany one plant alone was making 100 tons of liquid air a day. How many of those plants there were is not known. but that single plant was producing nearly as much as the total daily production of all the plants in England.

The second main application of liquid air or oxygen mentioned by Sir James Dewar is for supplying the oxygen needed by airmen at high altitudes. It has the advantage over the method of carrying the necessary oxygen compressed in steel cylinders that it is very much lighter. The liquid air is stored in vacuum vessels, and, volatilized under the influx of heat, is conveyed in tubes to mouthpieces, from which it is breathed by the airmen. Sir James Dewar showed three methods by which the influx of heat, and with it the amount of oxygen given off, can be regulated. In the first electrical heating is employed, and in the second a rod of copper or aluminum, gradually screwed down into the vessel, conducts energy into the liquid and volatilises it. In the third the liquid air is simply siphoned out through a stop-cock into an evaporating chamber, which receives its heat from the outer air, and is then warmed up to air temperature by being passed through a series of coils before it reaches the mouths of the airmen. By adjusting the stop-cock the amount of air delivered can be readily regulated.

GREATER CAPACITY WITH LESS PIPING

Pipe line engineers (oil) may find unusual interest in the plans of the Prairie Pipe Line Co. for its complete 65,000-bbl. pipe line system now in process of construction between Ranger, Tex., and Cushing, Okla.

The main principle embodied in the plans is the use of links of 12-in. pipe between each pump station, as being more economical than two additional continuous 8-in. pipes, and to give a greater capacity and ease of pumping.

When completed the arrangement of pipes between each pump station will be as follows: Starting from the pumps three 8-in. pipes will run out approximately a third of the distance toward the next pump station; for the remaining distance one 8-in. and a 12-in. pipe will carry the oil. The pump stations are at the usual intervals, approximately 40 miles apart. Pumps having a capacity of 20,000 bbls, will be used to start the oil off through the three 8-in. pipes.

The company has already demonstrated by 12-in. loops in other parts of its system that one 12-in. and one 8-in. at the outlet point coupled in proper ratio of distance with three 8-in. pipes coming from the inlet point, will increase the capacity of a continuous three 8-in. pipe line system by fully 10%—and this without additional pump power. As two 8-in. pipes cost more than a 12-in. of similar length a considerable saving in actual cost of pipe is effected. There is also a big saving in freight, drayage, and in putting the pipe down.

COMPRESSED AIR FOR SHAFT SINKING

BY P. W. BROWN

A very interesting and successful use was made of compressed air in the sinking of a shaft through mud and sand at West Calder, Scotland, by Thos. Borland. The surface overlying the regular stratified beds consisted of over 100 feet of loose sand and mud, some 50 feet of which contained a moderate quantity of water. The method of sinking decided upon was that known as brick tubbing. In this method a cast iron cutting-shoe, V shaped, the diameter of the shaft is built up on the surface. The one side of this V is vertical, and the other inclined. The inside of the V is filled with concrete and a brickwork forming the shaft lining is built thereon, which in this case was 2 feet in thickness. The weight of brickwork is, in ordinary cases, sufficient to cause the crib to sink, more brick work being added and the loose material filled out from the inside of the shaft.

As the depth increased in this case the resistance became so great that even 24 feet of brickwork above the surface level failed to make the crib sink. Iron joists carrying bars of pig iron were placed on top of the brickwork, and this only carried the sinking of the crib a dsitance of 17 ft., despite the fact that the top weight reached 1,000 tons. As a result of the crib coming to a standstill it was decided to sink beneath the cutting shoe to find the cause of stoppage. About 2 feet below the crib had been sunk when a mishap occurred. The mud which was sunk through was tough all over the shaft bottom except at one point. Here it was soft and latterly it burst in, bringing with it sand and mud from above in such quantities that the shaft was half filled in the space of a few minutes. The inrush left a hole on the surface and extended down behind the brickwork.

To prevent further movement of the sand and mud behind the brickwork, it was decided to bore holes in the brickwork and fit them with pipes through which cement was to be injected. Before commencing cementation proper it was considered advisable to apply compressed air freely to each of the holes in order to make sure that each was clear to take in the cement. In the course of this operation a very interesting discovery was made. When the compressed air had been applied to eight or nine of the lower ring of holes an unusual commotion occurred, which began by a heavy escape of air from beneath the crib. On examination it was found that the sand filling the inside of the shaft was approaching the platform on which the workers were standing. When the air was turned off the movement ceased. Similar applications of compressed air again gave similar results. Closer examination disclosed the fact that the commotion was due not to the sand rising in the shaft but was due to the crib sinking, an entirely unexpected, but none the less welcome occurrence.

It appeared that the air had been sufficient to cause the sand and mud to loose their grip of the brickwork and to allow it to slide down as required. The sinking of the crib closed the hole caused by the inrush of sand. Earlier application of compressed air would have expedited the sinking and reduced the cost considerably. The cementation proposal was carried out, and it was effective in holding back the 80 gallons per minute of water which was formerly finding its way to the shaft bottom.

CHEAPENING HELIUM AND OXYGEN*

When, at the suggestion of Sir William Ramsay, the British admiralty first studied the possible use of helium for balloon purposes they felt that the expense of production would be prohibitive. First, on account of the great scarcity of the element and the very great dilution in which it was found in the atmosphere and in other gases; and, second, because of the expense of the processes of separation then known to the admiralty.

When this information came to the United States bureau of mines it was remembered that some of the natural gases of Kansas had been found by Dr. H. P. Cady of the University of Kansas to have over 1 per cent. of helium in them. The separation of helium from these gases could best be accomplished by the same general processes of liquefaction and distillation as are used to separate air into its nitrogen and oxygen for industrial purposes.

It so happened that the metallurgical division of the bureau of mines had been making a study of these processes in the hopes of finding a way to sufficiently cheapen the production of oxygen from the air to allow its general use in metallurgical furnaces and other large scale chemical and industrial operations. If this were possible it would work a real revolution in these fundamental industries. Take, for instance, the smelting industry alone. We now concentrate everything that goes into the furnace except the oxygen of the air which we add with four times its volume of inert nitrogen and thus undo much of the effect of the concentration of the other constituents. It we could use pure oxygen, or more concentrated air, a great saving could be effected, and we could do in combustion furnaces much which is now only possible in the electric furnace.

---

*Dr. Frederick G. Cottrell, chief metallurgist of the Bureau of Mines, before the Chemists Club of New York.

One of the processes which the bureau has felt had much promise in this direction had not, up to this time, received any large scale development, but now these facts were all called to the attention of our army and navy, who immediately jointly appropriated first $100,000 and afterwards further sums now aggregating over $1,000,000, for trying out the project not only along the line of the new process but also parallel therewith by the older and better known processes as well, and entrusted the general direction of this work to the bureau of mines.

The plants on the older processes are already producing helium in large quantities and the one on the new and what is hoped may prove several times more economical is just about to have its practical production test. If it fulfills anticipations, its significance is far wider than the production of helium for it will open the possibility of oxygen in quantities at costs undreamed of by most chemists.

EMPLOYING THE WINDS IN ROAD BUILDING.

Utilization of the elements in sand road construction, is the radical plan developed and repeatedly employed with success by D. W. Jones, district highway superintendent of Curry, De Baca, Guadalupe and Roosevelt counties, New Mexico. Ignoring all the old and conventional methods of road building across sand wastes, the Jones system has been employed on some 80 miles of highway in the border state with very satisfactory results. His system in substance is to throw a trench through the sand, extending down to the clay bottom and then let the desert winds finish the job.

First tests of the Jones system were made on the Delphos road in Roosevelt county. This experimental strip included a nine-mile sand stretch, seven miles of which consisted of sand more than 30 inches deep with pockets of unknown depth. The work was handled by a state highway crew under Jones' supervision.

Following the clearing of the right of way of grass and weeds, the first step in the experiment, the sand was taken out down to hardpan. Removal was accomplished with Fresno scrapers, and deposited in waste stacks at some ten feet from either edge of the cut. Bottom width of the cut was approximately 12 feet. Between high walls of loose sand a narrow strip of clay road was constructed and left to wind action. Spring and Fall winds swept away the sand remaining on the surface of the clay and widened the strip from its original 12-foot span to 35 feet over all for the entire nine-mile length.

Unusual irregularity marked the clay surface while sand pockets ranged from 30 inches to five feet in depth. Grading of the surface was delayed until the waste stacks by the roadside had disappeared and the widening of the surface by wind action had taken place. Where pockets were less than 30 inches deep they were left to wind action and vehicle travel to eradicate. Where pockets greater than 30 inches in depth existed, clay was hauled to fill them.

After three years test the Delphos road experiment proved so successful that the Jones plan was adopted on a dozen different sand beds in eight other counties of the state. These included the following: Clovis-Montrose sand bed, 7 miles; Kennes-Chaves county sand bed, 6.3 miles; Fort Sumner-Ricards sand bed, 10 miles; Evanola-Yeso sand bed, 5 miles; Thompson-Near road, 9 miles sand; Elida-Jenkins road, 10 miles; Portales-Loving road and Alamogordo-Newman road. The latter two stretches composed more than 30 miles of sand beds, sand hills and sand dunes and other obstacles of this nature. At present all of these roads are open to traffic and in almost every instance the worst stretches previous to the Jones treatment, now are the best.

INFLAMMABILITY OF CARBONACEOUS DUSTS*

BY H. H. BROWN

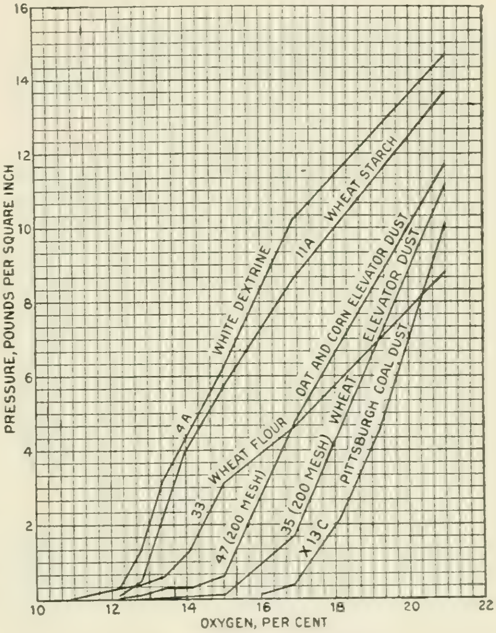
Severe property losses, in some cases attended by the destruction of human life, have occurred because of the fact that dusts from all materials which will burn are explosive. The Grain Dust Explosion Investigation Laboratory of the Bureau of Chemistry has investigated the explosibility of such dusts, with a view to ascertaining ways to reduce to a minimum the danger from dust explosions and fires in mills, grain elevators and cotton gins.

The relative inflammability of various dusts was determined in the laboratory, using a modification of the method devised by the Bureau of Mines for testing coal dust. Briefly, this method consists in forcing a cloud of dust (75 milligrams), which will pass through a 200-mesh screen, against a platinum-covered heating element, placed in the centre of a round glass globe with a capacity of approximately 1400 cubic centimeters. The pressure produced by the ignition of the dust was measured by a steam pressure gauge.

The results obtained from a number of tests conducted in this way indicate that the pressure (expressed as pounds per square inch) generated by the ignition of several different types of dust varies from 17.5 in the case of lycopodium and 15.2 for yellow corn dust from the first break in dry milling, through 13.2 for wheat starch, 11.3 for rice starch and 10.1 for Pittsburgh standard coal dust, to 3.2 for potato starch and 1.1 for gelatin dust from an elevator. Abviously, the dusts tested are highly inflammable, so that a cloud of any one of them suspended in the air forms a dangerous condition.

In the laboratory tests on the inflammability of coal dust, oxygen was employed to blow the cloud of dust against the heating coil, thus creating an atmosphere containing a greater amount of oxygen than is present in ordinary air. The pressures thus obtained exceed those secured when air alone is used. Conversely, lower pressures are shown when the surrounding air is deficient in oxygen.

A series of experiments was conducted to determine the possibility of employing an inert gas, or one lacking in oxygen, as a means for the prevention of dust explosives in industrial plants. The apparatus used was similar to that already described, with the addition of a device which permitted the filling of the explosion chamber with gas of any desired composition. In this way five typical dusts were tested, using gas mixtures ranging in composition from 16.9 per cent. oxygen, 4 per cent. carbon dioxid, and 79.1 per cent. nitrogen to 10.9 per cent. oxygen, 9.2 per cent. carbon dioxid, and 79.9 per cent. nitrogen. The results of this test are clearly shown in the accompanying diagram.



TESTS OF TYPICAL DUSTS

It is evident that an explosion of any of these dusts, which may be regarded as typical carbonaceous dusts of the more inflammable varieties, cannot occur in an atmosphere containing 12 per cent. or less of oxygen, the rest being inert gases. If elevator dusts alone are considered, this limit is extended to 14 or 14 1-2 per cent.

Tests conducted on a larger scale, using standard size milling machinery, have shown that it is possible to prevent explosions in these units by means of an atmosphere of inert gas. Results of such tests are now being prepared for publication.

Journal Ind. Eng. Chem.

THE GEOPHONE FOR MINE SAFETY

The geophone, a listening instrument invented by the French during the war to detect enemy sapping and underground mining operations, and for the location of enemy artillery, is now being used by the United States Bureau of Mines as a possible aid in locating miners who have been entombed after a disaster. The instrument was developed by United States engineers during the war and is now used by the bureau according to plans drawn by these engineers.

The instrument, though small, is essentially a seismograph, since it works on the same principle as the ponderous apparatus with which earthquake tremors are recorded.

During the period of the war engineers of the Mining Division of the Bureau of Mines were engaged in determining the distance that different mining machines could be heard through the clay shale coal and the mine cover. Measurements were made also of the energy required in blows that they be heard definite distances through clay, shale and coal, as well as the distances at which the shock waves resulting from the discharge of various explosives could be heard. A brief investigation of the factors influencing the transfer of energy from a mining tool to the clay and coal was also made in order that recommendations could be made as to the type of mining machine which could be used to accomplish the most work with the least noise.

In this connection it was found that sounds were transmitted only about half as far in clay as in shale strata and about one-quarter as far in clay as in coal. To give some idea of the sensitiveness of the instrument it may be said that pounding with a pick on the bituminous coal can be detected for a distance of 900 feet and the direction determined, and that pounding with a sledge can be heard as far as 1,150 feet. These measurements were made in the Pittsburgh coal seam in the vicinity of Pittsburgh, where the coal is somewhat harder than in most other bituminous coal beds. The explosion of a one-ounce charge of dynamite was detected a distance of over 2,000 feet through the shale strata. One interesting feature of the instruments is that the sound as transmitted to the ear is very characteristic of the instrument producing the sound. To illustrate: Twelve mining and carpentering operations were carried out on the coal rib. An engineer of the bureau who had never used the geophones and who did not know what tools were to be operated was able to recognize and name nine of the instruments at a distance of several hundred feet through the strata. The other three sounds were accurately described, but the machines were not identified.

Now that the war is over the bureau work has turned to the development of the instruments for peace time uses. In this connection it is thought they may be of great value to mine rescue crews who may be entering mines for exploration and to locate miners who may have been entombed after a disaster. The tests so far made in the vicinity of Pittsburgh show that a man pounding on the coal rib with a pick, piece of timber, or a sledge can be detected and located from a point 600 to 1,200 feet distant. This distance depends greatly on the character of the coal upon which the man is pounding, and intervening rooms and entries seem to have surprisingly little effect upon the distance or the determination of direction.

It is also thought that they will be of value to prevent accidents from explosions when breaking through. In this connection an interesting incident happened recently. Observations were being made at a tunnel heading. The pit boss happened along and asked to be allowed to listen. He put the ear pieces in his ears and remarked: "Mack is tamping in a charge, we had better move away."

VARIOUS FAN DATA

The theory of fans, although simple, cannot entirely be applied in the construction of fans. Each maker calculates his designs upon coefficients obtained from experiments with earlier fans, and these coefficients, as well as the constructive details, vary widely. For the same output fans differ in speed, diameter, width, height, and angle of vanes. From the curves for pressure and power referred to the delivery volume and efficiency curve can be deduced. The problem for the builder is to construct a fan to deliver the desired volume under the desired pressure at the highest possible efficiency—that is, with the least expenditure of power. The theoretical pressure-volume curve is a straight line, but the actual curve is of parabolic form, with probably only one point common to both curves.

The author of a recent article illustrates a series of nine vane angles for a given fan and discusses their relative merits, pointing out that it is now considered desirable to couple the electric motor direct to the fan, which must run at a high speed to keep the cost of the motor down.

The Oerlikon Machine Company instructed the author to make a series of tests to decide upon the best angle of the vanes. Three fans, precisely similar except for the angle of the vanes, were tested in the same case at the same speed, and the results are plotted in the form of curves, and from these the three curves of efficiency are shown together so as to be readily compared. The maximum efficiency attained was 78 per cent.; the delivery was then 3.25 cubic metres per second, and the speed 1,400 revolutions per minute; the pressure was 242mm. of water, and the power required was 12.25-hp. He also gives curves for a smaller and a larger fan; the former showed an efficiency of 64 per cent., with a delivery of 40 cubic metres per minute and pressure of 78 per cent. of water, with 1.06-hp., while the latter gave 86.8 per cent. efficiency, with 3.78-hp., delivery of 110 cubic metres per second under a pressure of 228-mm. of water. These results are stated to agree very closely with the theoretical calculation.

WESTINGHOUSE NOT TO BE BRAKED*

After Westinghouse had developed the plans of his first air brake, he laid them before many different railway men. He met with rebuff after rebuff. Finally a man named Baggaley, of Pittsburgh, became interested in Westinghouse and his schemes, and Baggaley wished to put some money into development work. Westinghouse, however, was reluctant to let his friend assume the risk till both felt sure they were on solid ground. Baggaley suggested that they submit the plans and drawings of the brake to the best mechanical expert in Pittsburgh.

Westinghouse consented, and this was done. The expert gave the subject his careful scrutiny, and in the course of a fortnight handed back a written opinion, which was read with feverish eagerness. It was a sweeping condemnation of the whole scheme as not only unsound, but nonsensical. Baggaley hurried with the paper to Westinghouse, who went over it twice before handing it back. The rising color in his face showed that he was angry, but he gave no immediate vent to his feelings.

"How much did your expert charge you for that death sentence?" he asked after a little.

"One hundred dollars."

"Well, what are you going to do about it?"

"Watch me and see." And Baggaley, setting his teeth hard, tore the manuscript into ribbons and threw it into the grate. As it did not catch at once, he struck a match and lighted the little pile, standing over it till the last fragment of paper had been turned into ashes, and the smoke from it had disappeared up the chimney."

And they went ahead.

Again in 1887 Westinghouse met disappointment. In the Burlington trials his air brake was in competition with a number of brakes of other makes.

The Committee's report was generally favorable to a brake operated by air, having valves operated by electricity—a verdict against brakes operated by air alone.

Among the technically trained observers probably the only one who did not read in this turn of affairs an end of the dominance of Westinghouse in his special field was Westinghouse himself. To a friend who attempted to say something comforting, he turned a face, which, though serious, was entirely cheerful.

"What are you going to do now?" asked the friend.

"What I have left undone hitherto," he answered—"perfect my air brake."

HIGH OR LOW VACUUM

The lack of a separate system of terminology for mechanical pressure is due, no doubt, to the self-suggesting analogies with altitude, which made the old altitude expressions readily understood in their new applications. It is really difficult to imagine anything more natural than that a large number of pounds pressure should be spoken of as "high," or that a relatively small number of pounds should be known as "low." It is only when we go below the datum level of atmospheric pressure that the analogies become less apparent, and we find ourselves groping among needless inconsistencies and foolish contradictions.

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*W. E. Woodward, at N. Y. Railroad Club.

Take a homely example. A man whose property is 500 feet above sea level erects a flagstaff 80 feet high. The top of his flagstaff is 580 feet high, if he is speaking to a topographical engineer; and it is 80 feet high, if he is reeving off halyards. The steam engineer follows him exactly with 14.7 pounds per square inch corresponding to the 500 feet elevation, 200 pounds aboslute corresponding to the 580 feet, and 185.3 pounds gage corresponding to the 80-foot flagstaff. But suppose the property owner digs an 80-foot well. The bottom of the well is 420 feet "high" above sea level; and it is also 80 feet "deep" when referred to the surface of the ground—being "high" or "low" according as it is viewed from sea level or from the locality. The steam engineer makes fairly good weather of it so long as he speaks of "one pound absolute pressure," but he gets hopelessly lost when he looks down 13.7 pounds below atmospheric pressure and calls it "28 inches vacuum." He is almost sure to call it a "high" vacuum, which might be permissible, if we could also speak of a "high" well. It is almost equally certain that he will speak of "amount" of vacuum, whereas a man who spoke of "amount" of well or "amount" of flagstaff would be tapped for the simples.

Since we have irrevocably adopted the altitude ideas of "high" and "low" for expressing the relative degrees of pressure, and, since it is unquestionably desirable to be consistent throughout the entire range, it is suggested that the term "deep vacuum" be used instead of "high vacuum," and that the term "depth of vacuum" be used instead of "height of vacuum," "amount of vacuum" and similar expressions—*Q. B. Newman, in Marine Engineering.*

NEW JOB FOR SAND HOGS

In our list of U. S. patents in our present issue there is one covering a process for making hollow rubber articles and the first claim of the patent is as follows: The process of making hollow articles of plastic material consisting of bringing the parts together within a room occupied by the operator and containing air under pressure.

NOTES

The following is in a bill before the Missouri legislature: "The county highway engineer shall receive the same compensation as is now provided by law for the prosecuting attorneys in the various counties of this state, and his salary shall be computed and paid on the same basis as now provided by law in relation to the office of prosecuting attorney."

A novel application of cold storage is mentioned in *Chambers's Journal.* Fruit farms in California were troubled with a plague of aphides, so ladybirds were gathered from their hibernating places and put in cold storage until the greenfly began to appear next season. The ladybirds quickly exterminated the aphides.

If you believe that prices of commodities are going to drop all of a sudden, then don't plan for to-morrow at all! Don't buy a new shirt or a new collar or a new suit of clothes. May be next week they'll only cost half as much as they do to-day! May be! But the man who would act according to such a rule would be standing still, and perish in the dry rot while the rest of the world is going ahead.

Slate pencils made of talc are now being manufactured in Johannesburg, South Africa. In order to meet the large demand which has developed, a new machine has been designed, and is being made locally, which will be capable of turning out about 40,000 pencils per day. From this we may infer that they have not yet thrown away their school slates.

It is mentioned in the *Scientific American* that the General Electric Co. has conducted experiments on ingot iron with a view to determining how soft this iron may be made by proper treatment. It is stated that if ingot iron is surrounded by hydrogen for three hours at 1,600 degrees F., and slowly cooled, it will become about as soft as soft copper.

A British newspaper, commenting on the deplorable state of affairs in Belgium, states that shortly after the Armistice was signed the need for sewing cotton was found to be so great that a ton was immediately despatched by aeroplane.

Prices—and wages—are not going to come down in a hurry. Even if it does cost you more to produce an article, more to live, than before the war, you are also getting better prices—better wages. There's a new price level all around.

Hair Driving Belts were first considered as an economic possibility as soon as the Chinese as a nation came to the conclusion that the possession of a pigtail was not an essential passport to heaven. A large number of discarded queues were utilized in the manufacture of driving belts, being made up with coarse camel hair and wool rejects.

A doubtful period is the wrong one in which to hesitate. When in doubt, boost—push—hustle! Dig up all those odds and ends of business you once considered too small to bother with. Keep up your stock as well as your good spirits. Look prosperous, and pretty soon your neighbors will begin to think you are prosperous. And, when they see that you are kept busy while your competitors are stagnating, they will naturally conclude that you are the best man in your line to do business with—and, before long, you will really *be* prosperous. If conditions don't suit you, change them! Make prosperity!—*Du Pont.*

Equinoctial disturbances in the shallow rivers back of the Gulf of Mexico have called the attention of natives to a somewhat neglected method of procuring dyes. The waters abound in cuttle fish, which are now being driven ashore, and which, when alarmed exude a black, paste-like substance which discolors the water and hides the fish from view. This substance gradually comes to the surface in a foam and can be kneaded, pressed into cakes, sold and eventually made into inks or dyes.

In discussing the possibilities of cutting cast iron by means of the acetylene blowpipe, *Teknisk Tidskrift* says that heavy castings can be perforated in a few seconds by blowing the flame through a wrought iron tube in which iron wires are inserted. The part to be operated on is first brought to a bright red heat with an ordinary flame, and immediately oxygen at an initial pressure of 15 atmospheres is admitted the molten metal is thrown out with such force that the work cannot be performed without asbestos clothes and gloves. Castings 2 ft. thick, it is said, can be perforated in two minutes and large castings removed in pieces by fusing holes in suitable places, and allowing the castings to crack as they cool.

Writing in the *Monthly Weather Review,* Mr. George N. Cole sets forth detailed arguments to prove that the hot blast which swept over the city of St. Pierre during the eruption of Mont Pelée, as well as similar blasts in connection with the eruption of Vesuvius that destroyed Pompeii and Herculaneum, the eruption of Taal, Sakurajima, etc., derived its heat from the sudden compression of the air surrounding the volcano, and not from conditions in the volcano itself. In other words, it was not, according to this hypothesis, an outpouring of hot crater gases that caused the destruction, but the dynamic heating of the air attending the propagation of the explosion wave. Mr. Cole cites a number of interesting observations at St. Pierre after the Martinique disaster that seem to support this idea.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

FEBRUARY 4.

1,292,987. AUTOMATIC TRAIN CONTROL AND SIGNAL APPARATUS. William E. Backus, Fitchburg, Mass.

1,292,988. AIR-PRESSURE PLUG. Mark J. Bacon, May, Cal.

1,293,041. GAS-MIXER. Frederick A. Coleman, Cleveland Heights, Ohio.

1,293,080. FLUID-MOTOR. George H. Gilman, Claremont, N. H.

1,293,081. DRILL-TOOL. George H. Gilman, Claremont, N. H.

1,293,178. PNEUMATIC CONTROLLER. John L. Osborne, Rochester, N. Y.

1,293,225. ROCK-DRILL. William A. Smith, Denver, Colo.

1,293,227. FLUID-PRESSURE GOVERNOR. Arthur L. Smyly, Chicago, Ill.

1,293,250. SUCTION CLEANING APPARATUS. Walter G. Trautman, Cleveland, Ohio.

1,293,251. SADDLE FOR PNEUMATIC HAMMERS. Robert J. Troeger, Los Angeles, Cal.

1,293,262. FLUID-MOTOR. Timothy T. Walker, Buffalo, N. Y.

1,193,294. VACUUM-INSULATED VESSEL AND CASING THEREFOR. George P. Altenberg, Cincinnati, Ohio.

1,293,396. GAS-OPERATED MACHINE-GUN. Ansley H. Fox, Philadelphia, Pa.

FEBRUARY 11.

1,293,663. MEANS FOR COOLING COMPRESSED AIR ON LOCOMOTIVES. Earl A. Averill, Mount Vernon, N. Y.

1,293,683. VACUUM-FUEL-FEED DEVICE FOR INTERNAL-COMBUSTION ENGINES. James L. Breese, Jr., Washington, D. C.

1,293,729. WIND-INDUCING DEVICE FOR SELF-PLAYING MUSICAL INSTRUMENTS. Lewis B. Doman, East Syracuse, N. Y.

1,293,789. VALVE MECHANISM FOR VACUUM FEED DEVICES. Webb Jay, Chicago, Ill.

1,293,790. MULTIPLE-ACTION VACUUM FEED DEVICE. Webb Jay, Chicago, Ill.

1,293,886. ENGINE STARTING DEVICE. Horatio N. Norton, Los Angeles, Cal.

1,293,896. ELECTRIC FLUID-HEATER. Jens A. Paasche, Chicago, Ill.

1,293,933. POP-GUN. Ernest S. Roe, Plymouth, Mich.

1,293,960-1. ROCK-DRILL. William A. Smith, Denver, Colo.

1,294,058. PNEUMATIC STARTER FOR AUTOMOBILES. Thomas Davis, Detroit, Mich.

1,294,073. AUTOMATICALLY-CONTROLLED HUMIDIFYING APPARATUS. Guy S. Faber, Springfield, Ill.

1,294,103. VACUUM LIFTING DEVICE. Halbert K. Hitchcock, Pittsburgh, Pa.

1,294,188. PRESSURE-CHAMBER FOR REMOVING DIVERS' DISEASES. Hermann Stelzner, Lubeck, Germany.

1,294,190. AIR-BRUSH AND SIMILAR APPARATUS. Herman Edward Sturcke, Brooklyn, N. Y.

1,294,266. PNEUMATICALLY - OPERATED ELEVATING MECHANISM. Frederic W. Hogg, Hillsdale, Oreg.

1,294,271. METHOD AND APPARATUS FOR RAISING OR FORCING LIQUIDS. Merbert Alfred Humphrey, London, and William Joseph Rusdell, Dudley, England.

1,249,319. GLASS-BLOWING MACHINE. Frederick W. Stewart, Beaver, Pa.

FEBRUARY 18.

1,294,369. AUTOMATIC AIR-GAGE. George L. Banks, Huntington Park, Cal.

1,294,468. MOTOR-DRIVEN SUCTION-SWEEPER. Emma Hunsicker, Milwaukee, Wis.

1,294,473. VACUUM-CLEANER. James B. Kirby, Cleveland, Ohio.

1,294,532. FLUID-DISTRIBUTING VALVE MECHANISM. Demetrius M. Radovanovitch, Pittsburgh, Pa.

1,294,551. HUMIDIFYING OR SPRAYING APPARATUS. Herbert Smethurst, Hollinwood, England.

1,294,808. DEVICE FOR ACCUMULATING WAVE-POWER. Charles Francis Jenkins, Washington, D. C.

1. In apparatus of the class described, the combination with a compressed air chamber, of a passage leading into said chamber and open to receive incoming waves of water, a check valve located in said passage in position to receive the impact of incoming water and to allow it to enter the chamber and prevent its return, a reservoir at a higher level than the chamber, a conduit leading from the chamber to the reservoir, and a check valve allowing water to pass, in the conduit, toward said reservoir and preventing its return.

1,294,869. AIR-COMPRESSOR. George P. Bump, La Crosse, Wis.

1,294,870. COMPRESSED-AIR STARTING APPARATUS. George P. Bump, La Crosse, Wis.

1,294,875. SUCTION CARPET-CLEANER. Frank S. Chase, Torrington, Conn.

1,294,877. WIND-MOTOR. James H. Connolly, El Paso, Tex.

1,294,910. AIR-MOTOR. Valentine G. Hyatt, Jr., Welby, Utah.

1,294,978. FLUID-PRESSURE BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,295,000. AIR HEATING AND REGULATING MEANS FOR INTERNAL-COMBUSTION ENGINES. Howard Brooks, El Paso, Tex.

1,295,010. FLUID-PRESSURE BRAKE. William E. Dean, Wilmerding, Pa.

1,295,036. VACUUM FUEL-FEED DEVICE FOR INTERNAL-COMBUSTION ENGINES. Webb Jay, Chicago, Ill.

1,295,089. METHOD OF AND APPARATUS FOR TREATING GUNCOTTON AND THE LIKE. Frederick D. Crane, Montclair, N. J.

5. The herein described method of preventing the premature explosion of a mass of wet gun cotton while being treated in a centrifugal drier, which consists in suddenly reducing the pressure of the gaseous medium surrounding the mass at a definite stage in the drying process, whereby the resulting rapid vaporization of the contained liquid serves to cool and loosen up the mass.

FEBRUARY 25.

1,295,198. PIANO-PLAYER. Claus E. Peterson, Worcester, Mass.

1,295,248. PNEUMATIC SYSTEM FOR CLEANING COAL OR ORE. William E. Winn, Pittsburgh, Pa.

1,295,235. AIR-BRAKE SYSTEM. Earl G. Taylor, Bellevue, Pa.

1,295,247. AIR AND GAS MIXING DEVICE. Robert W. Wiederwax, Atlantic City, N. J.

1,295,256. DIRECT MOTOR-DRIVEN COMPRESSOR FOR AIR AND OTHER FLUIDS. Mario Balloira, Turin, Italy.

1,295,282. AUTOMATIC AIR-BRAKE-HOSE COUPLING. Samuel M. Dick, Minneapolis, Minn.

1,295,416. AIR-CONDITIONING APPARATUS. Arthur Francis Berry, London, England.

1,295,417. COOLING OR COOKING BOX. Arno Boerner, Scheveningen, Netherlands.

1. An apparatus of the character described, comprising a casing having an airtight cover and adapted to receive the food or the like to be treated, a jacket surrounding the casing and forming an air space, a second jacket surrounding the first jacket and forming a water chamber, means for permitting water to flow through said chamber, and means for evacuating the air from said air space.

1,295,422. AIR-COOLED STORAGE-HOUSE. Alfred G. Brown, Chicago, Ill.

1,295,446. PNEUMATIC WATER-ELEVATOR. Felix Denizet, Perryville, Mo.

1,295,451. GREASE-GUN. Edward J. Duffey, Seattle, Wash.

1,295,471. PNEUMATIC JACK. Louis A. Fleury, Indianapolis, Ind.

1,295,491. AUTOMOBILE-TIRE PUMP. George E. Hazard, Rochester, N. Y.

1,295,511. COW-MILKER PUMP. Magnus Edward Jernberg, Cowdery, Manitoba, Canada.

1,295,529. AIR-COMPRESSOR. James W. Lawhead, Wilmington, Ohio.

1,295,635. PROCESS FOR OBTAINING NITROGEN FROM AIR. Nobile Carlo Tommasi, Basel, Switzerland.

1. The described process for obtaining nitrogen from air wherein the air is passed through a solution of ammonium sulfite on the counter-current principle until the oxygen has been removed from the air to such an extent that the remaining nitrogen contains less than 1 per cent of oxygen.

1,295,668. PNEUMATICALLY - OPERATED MUSICAL INSTRUMENT HAVING HAMMERS. Adalbert Zollinger, Leipzig-Eutritzsch, Germany.

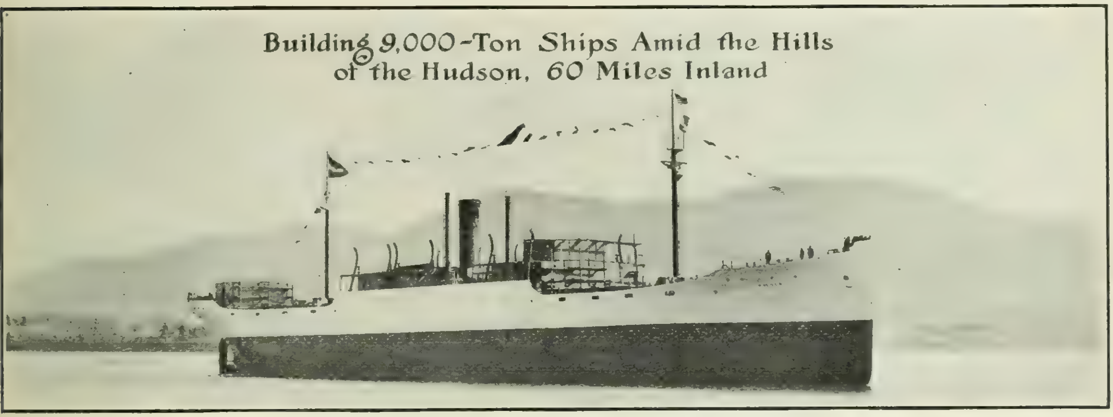
1,295,672. PNEUMATIC ACTION FOR MUSICAL INSTRUMENTS. Willis E. Austin, Minneapolis, Minn.

1,295,724. AIR-REFRIGERATING MACHINE. Julius Frankenberg, Chicago, Ill.

COMPRESSED AIR MAGAZINE

Vol. XXIV JUNE, 1919 No. VI

Air Uses at Newburgh Shipyards Plant



Building 9,000-Ton Ships Amid the Hills of the Hudson, 60 Miles Inland

By *FRANCIS JUDSON TIETSORT*

SIXTY miles inland from New York Harbor, up the scenic Hudson, between its dimpled expanses of hills where they attain almost to the dignity of mountains, in a 35-acre shipyard encroaching upon the waters of that noble tidal stream, are being built 9,000-ton capacity steel steamships for the merchant deep-sea service of American trade. A spot highly favored by nature, where the last of the proud Mohicans relinquished sadly their favorite fishing and hunting grounds to pioneering white men, it was found a singularly appropriate and convenient place for the construction of giant steel merchant ships.

Hendrik Hudson, explorer-navigator in cockleshells, who sailed 310 years ago up the placid reaches of the stream bearing his name, passing the very cove or widening in the river that now resounds with the rat-a-tat-tat of the air riveter, would be overcome with amazement to see the activities at Newburgh, N. Y., to-day! Another celebrated gentleman with whom the name of the river is appropriately linked, Mr. Robert Fulton, who came along two centuries later with his steam-propelled contraption, the *Clermont*, would doubtless be no less overwhelmed, could he now witness up-river shipbuilding developments in vapor-driven craft. In fact, even Newburgh itself has been pleasurably disturbed out of the even-going tenor of its quiet ways!

Two years ago the ebb and flow of the tides swept into a little bay south of Newburgh on the west bank of the river where there was 25 feet of water. After Irving T. Bush of New York had talked over with engineering and naval architect friends the matter of engaging in a shipbuilding enterprise and had reached a decision, several keen-eyed men journeyed up the Hudson and made notes on slips of paper. They returned to New York with significant reports. As a result hundreds of men began dropping off West Shore trains at Newburgh. The furnished room market in the town took on boom proportions and the community came to realization of having a housing problem on its hands. Six weeks before, the

United States had decided momentously to get into the great European conflict and see it through to a finish. The nation had to have ships, more ships, by the millions of tons. Newburgh found itself suddenly right up on the firing step of the Second Line of Defense.

When 4,000 workmen and their families are dumped rather precipitately into a community of 32,000 souls, all hands have to step lively for awhile. Newburgh began to seethe and boil with activity. Railroad gangs began laying spur tracks; steam shovels plowed into the hill alongside the West Shore Railroad right of way; materials began to arrive by the hundreds of carloads. Before a shipbuilding plant could be built 32 acres of area covered by that 25-foot depth of water had to be filled in and thousands of piles had to be driven to make a secure foundation for the ways on which thousands of tons of steel were to rest.

The town took on almost metropolitan speed. It was a fair sample of America rolling up its sleeves and getting into action behind the 3,000,000 men it began training for military service.

Before Newburgh Shipyards, Inc., had taken on even its outward legal form as a company, the promoters began scouting about the country for air compressing equipment—a commentary on the importance of air equipment in shipbuilding. Building ships without it in normal times would almost be tantamount to a steam engine without steam. In wartimes, when speed in shipbuilding was synonomous with rapidity in riveting and dependent also upon pneumatic tools and many other pneumatic devices, high-grade air compressor equipment was absolutely indispensable.

Meantime hundreds of other plants for shipbuilding and other war industries were confronted by the same situation as regards their air needs; compressor apparatus was at a premium. Machinery men were speculating even in second hand compressors and making large profits.

To give an idea of the extent to which compressed air is utilized in modern steel shipbuilding it may be noted that in the construction of one of these Newburgh cargo carriers there was required the driving of 550,000 rivets, the reaming of 500,000 holes and the calking of 40,000 lineal feet of seams to make the ship watertight.

The embryo company went into the market before its incorporation and bought two large Rand compressors that had seen service at Ashokan Dam on New York City's water supply system. These met the requirements until a later purchase was effected of an Ingersoll-Rand "PRE Type," direct-connected, electrically driven compressor, which now bears the brunt of the load for compressed air requirements at the plant, only one of the old machines being utilized.

Owing to the fact that the compressors were to be installed upon piles and earth fill, the foundations were made much larger than the specifications furnished by the makers called for. This was a wise provision, for scarcely any vibration can be noticed in the Newburgh shipyards power house. In another installation, recently inspected, the usual foundation had been employed with a similar footing of piles and fill and the vibration was so great that the entire power house was visibly shaken.

The work of building the Newburgh shipyards began on June 1, 1917. The 32-acre fill along the river front was accomplished by building a cross-over above the West Shore tracks, rock, sand and earth being dug by steam shovels from the high bank west of the railroad and transported across to the water in standard size dump cars. The laying down of the first ship took place on March 14, 1918, or eight and one-half months afterward, a truly remarkable performance. The ways had not yet been completed, but it had been made possible to begin ship construction.

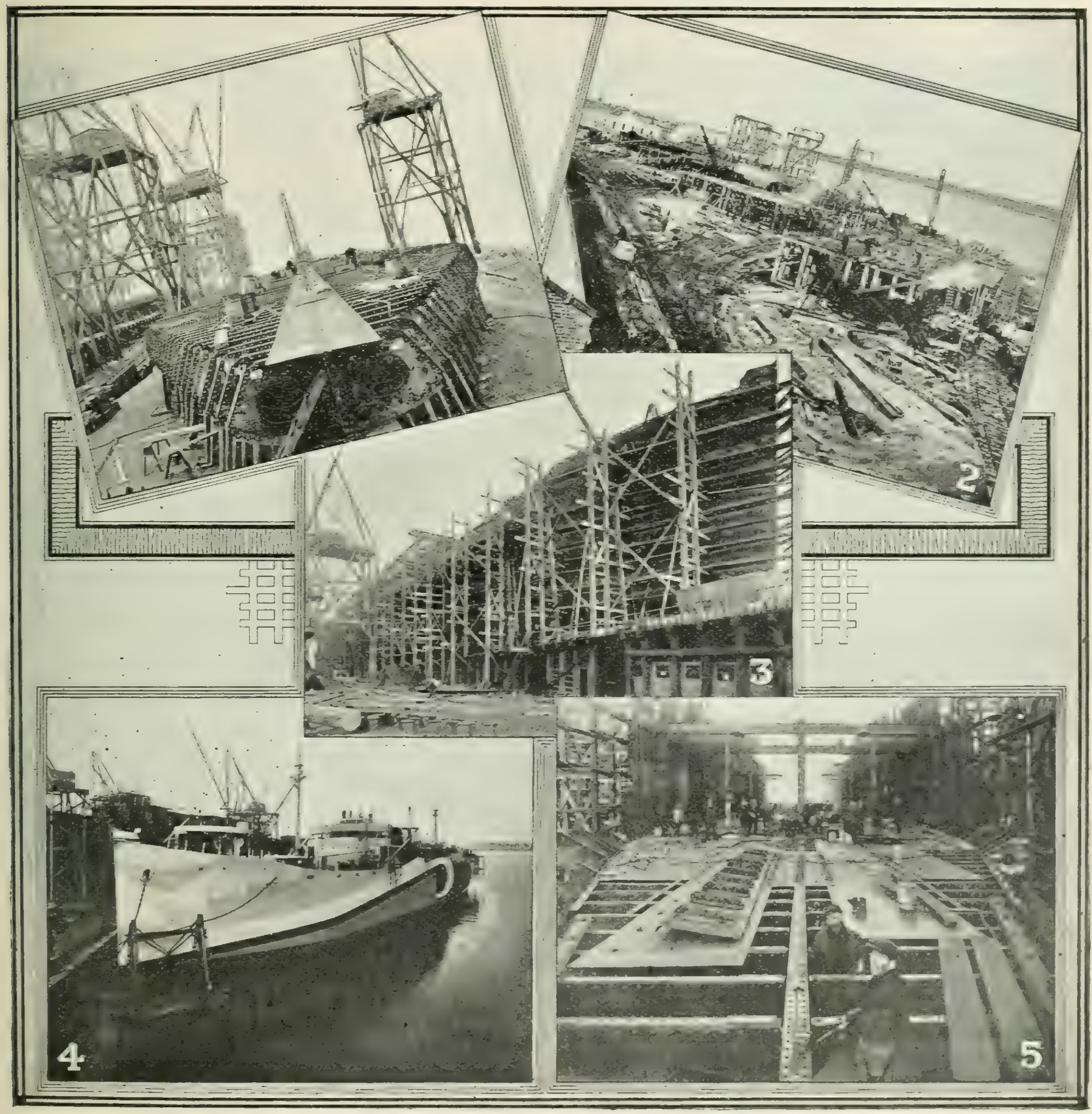
In less than six months thereafter, on September 2, 1918, there was launched the first of a series of twelve 9,000-ton cargo carriers, for which contracts had been awarded by the United States Shipping Board Emergency Fleet Corporation. This was delivered and accepted complete in December, in the quickest time for any ship of that tonnage on the Atlantic Seaboard. Six ships altogether have been launched since, four of them having been delivered, and four more are on the ways. The last two to complete the dozen, are yet to be laid down, following which steamers are to be built for the Union Sulphur Co. of New York and other private interests.

The vessels now under construction at the Newburgh yard are of the two-deck, three-island type, with two pole masts and one stack. Each mast carries four cargo booms of five tons' capacity, with a thirty-ton boom for handling heavy loads. There is a large hatch to each hold; those to holds, 1, 2, 4 and 5 are 29 feet 3 inches by 20 feet, and that to hold 3 is 18 feet by 20 feet. The crew is berthed in the poop, while the bridge deck enclosure is given over to cargo and the forecastle to storerooms, carpenter shop, lamp rooms, etc. The officers are housed in two houses on the bridge deck, the navigating officers occupying the forward and the engineering officers the after house. These vessels are of the following dimensions:

Length overall	417 feet 10 inches
Length between perpendiculars	401 feet

Breadth molded	54 feet
Depth molded	32 feet 10 inches
Designed draft	25 feet 6 inches
Deadweight carrying capacity	9,000 tons
Capacity for grain cargo	476,205 cubic feet
Capacity for fuel oil	1,260 tons
Capacity for bunker coal	1,846 tons
Capacity for feed water	137 tons
Capacity for drinking water	26 tons
Gross tonnage	6,000 tons
Net tonnage	3,783 tons

The vessel is driven by a 17-foot propeller operated by a Westinghouse turbine reduction gear. The turbine is designed for 3,600 revolutions geared down to 90 revolutions of the propeller shaft, giving an output of 2,800 shaft horsepower.

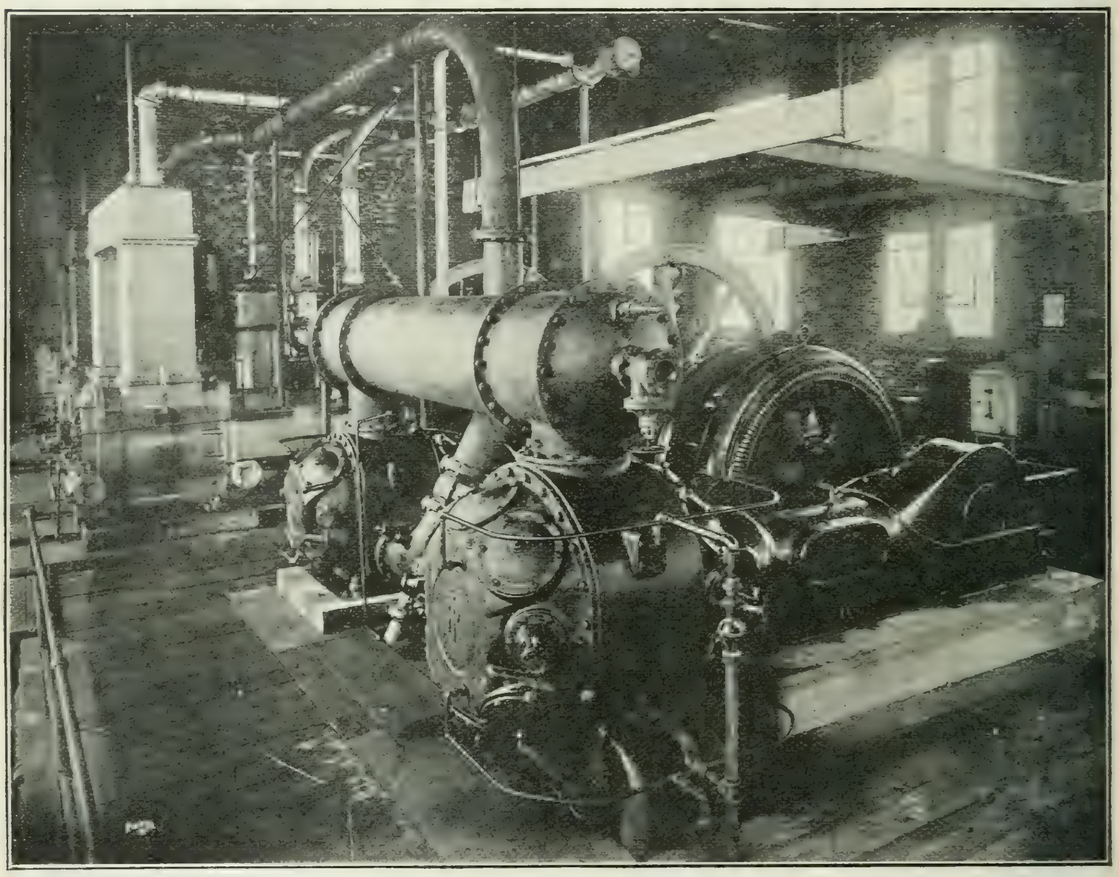


Views at the Newburgh Ship Yards Plant

1.—GENERAL VIEW OF 9,000-TON FREIGHTER LAID DOWN BEFORE YARD WAS FINISHED.
2.—BUILDING A SHIPYARD ON 32 ACRES OF "MADE" LAND ON THE RIVERFRONT.
3.—SIDE VIEW OF GIANT FREIGHTER ON THE WAYS.
4.—VESSEL RECEIVING CAMOUFLAGE DURING THE WAR.
5.—SETTING IN PLACE AND RIVETING DECK PLATES—INTERIOR VIEW.

A rigid specimen trial was that of the S. S. *Newburgh* before her acceptance and transference to the Naval Overseas Transportation Service. It was both an endurance and a speed test, her engines running at maximum capacity for twelve hours, of which three hours formed the speed trial. The trial data was as follows:

Duration of full speed trial, hours	3
Average revolutions per minute	94.94
Estimated shaft horsepower	35.50
Vacuum, inches	27.4
Fuel oil, pounds per hour per shaft horse power	1.34
Estimated speed, knots	12.4



Power House for Newburgh Air Plant

AT THE LEFT ARE TO BE SEEN TWO OLD TYPE RAND AIR COMPRESSORS FORMERLY USED AT ASHOKAN DAM, AND AT THE RIGHT THE NEW INGERSOLL-RAND COMPRESSOR NOW BEARING BRUNT OF THE LOAD.

The *Newburgh* far exceeded contract requirements and proceeded almost immediately on her first voyage to Europe.

The Newburgh shipyards achieved a very high degree of efficiency in riveting, and some fine individual records were made by riveting gangs. The spirit of the men, however, was not to perform the sensational in spurts, but to maintain a high steady average. As at many of the other yards throughout the country, score records were kept on blackboards, and in these records the men took the keenest pride. The good-natured rivalry that resulted had the effect of largely increasing production.

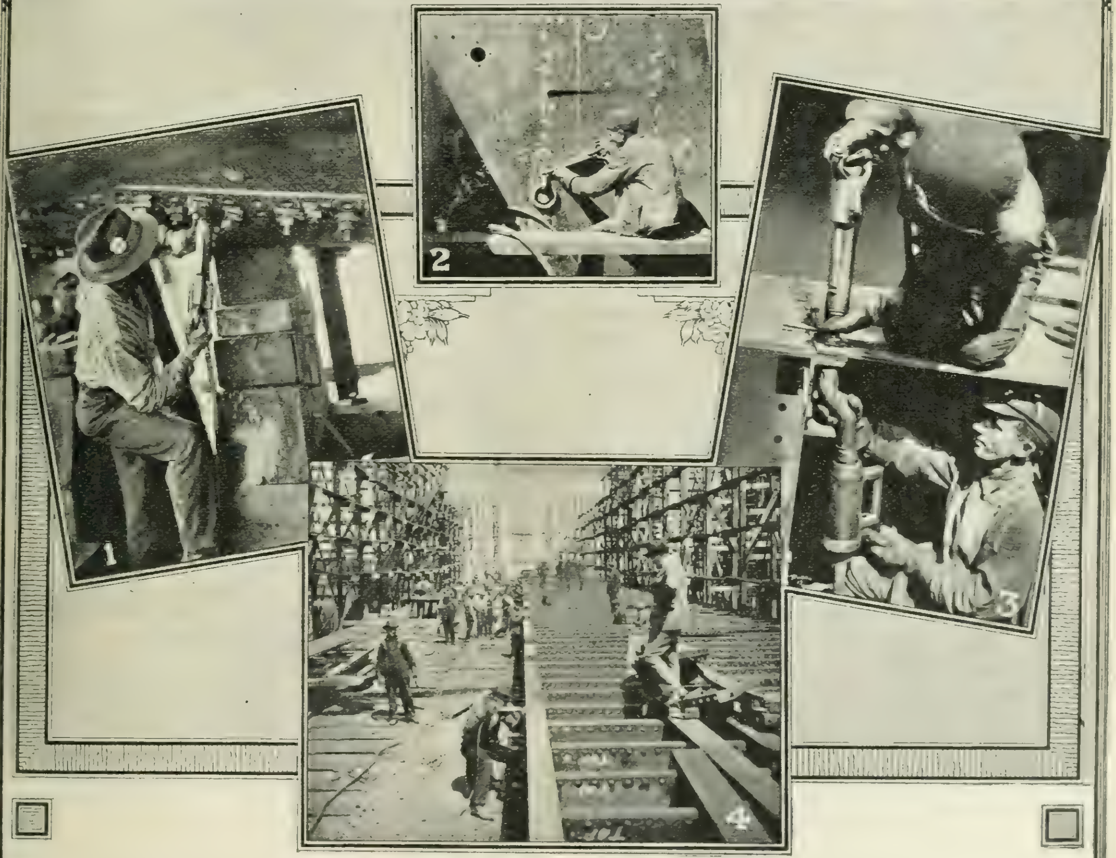
The Boyer and Ingersoll-Rand "Little David" riveting hammers and drills were used in this work, the latter equipment predominating. Supplied by the two steam and one electric-driven Ingersoll-Rand compressors previously mentioned, compressed air at from 90 to 100 lbs. pressure was piped 300 yards from the power house to the men using it. There were 400 men in the riveting gangs, and for six months, up to the time of the signing of the armistice, the Newburgh crews had the highest rating on riveting from the U. S. Shipping Board.

From the very beginning of the work at the yard 4,000 men were employed and the Newburgh executives had little or no difficulty, fortunately, in obtaining able-bodied and willing workmen. The pretty town of Newburgh and the shipyard itself, commanding a magnificent view of the up-river scenery, provided a pleasant environment for the workers, who have lived and labored under conditions making for contentment.

The officers and principal active executives of the Newburgh Shipyard, Inc., are as follows: Chairman, Irving T. Bush; President, T. C. Desmond; Vice President and General Manager, E. C. Bennett; Assistant General Manager, H. W. Sweet; Assistant Treasurer, H. G. Mullen; General Superintendent, James Mitchell; Naval Architect, James Preston; Chief Engineer, Alexander Robinson.

Through the courtesy of Mr. Bennett and Mr. Sweet, the writer was recently afforded an opportunity thoroughly to inspect the plant and to obtain a photographic record of what has been accomplished in "tall-water" construction sixty miles up the Hudson. The accompanying illustrations for this article will give a more graphic understanding than words of description.

Newburgh is to become a permanent yard and



Compressed Air in Shipbuilding

1.—RIVETING ON A KEEL PLATE WITH "LITTLE DAVID" HAMMER.
2.—CHIPPING OFF A BOLT HEAD WITH A "LITTLE DAVID" HAMMER.
3.—RIVETING A DECKPLATE, SHOWING HOLDER-ON BENEATH.
4.—GENERAL VIEW OF LAST NEWBURGH SHIP LAID DOWN, 4 DAYS AFTER LAYING KEEL.

is to go in for general commercial shipbuilding with the completion of its government contracts. The prospect for it in the next few years is excellent, for unlike some of the larger yards it will not be handicapped by too big an overhead expense. The present outlook is that the very large plants will be obliged to employ considerable ingenuity in reorganization and management in order to "break even" on private contracts.

Mr. Hurley and others have talked recently of shipbuilding at $150 a ton after government contracts have been completed, as against a war price of from $250 to $270 a ton, which is, of course, prohibitive in peace times. Vessels at $150 are based on a calculation that materials and labor costs will be down somewhere near to normal in the next eighteen months. Some construction authorities believe this price too low, certainly for the present. Revised estimates are that shipping will build at about $160 in from one year to eighteen months hence.

Meantime shipbuilding mechanics will be acquiring efficiency at their exacting craft. During the war green men were drilled in classes for six weeks and then put at work in gangs with more seasoned workmen, but a skillful shipbuilding mechanic cannot be turned out in six weeks, nor in six months. The Newburgh company trained about eighty per cent of its men.

The feeling at Newburgh, as I sensed it among the executives, is that it is not safe to make forecasts regarding the future of private shipbuilding in the United States until it is known definitely what the course of the Shipping Board is to be. There will be uncertainty while the Shipping Board remains in control of ocean shipping rates, in which it is not to be expected that the board's operatives can be so adept as are private shipping agents. This, at any rate, appears to be the sentiment in shipbuilding and maritime circles.

There is optimism over a likelihood that craft in the control of the Shipping Board will be auctioned or sold to private owners at a price around $150 a ton, the remainder of the wartime cost being written off by the government to the profit and loss account of war. At this writing this seems to be the only method by which the shipping situation can be adjudicated practically.

Mr. Hurley's $150-a-ton price theory, which merely as an idea may be revised later, of course, has had the effect of knocking in the head a good many private construction contracts that had been pending at somewhat higher prices. Prospective owners of bottoms naturally do not want to make a contract as long as there is any possibility that they can get vessels at $150 a ton, remote though that possibility may be. Many large private shipbuilding deals are afloat in the market at this time, but they cannot come to anchor in the various yards until the matter of price is settled.

I asked Mr. Sweet at Newburgh what he thought of the possibility of salvaging ships sunk by submarines during the war.

"I'll lay you a wager," he replied, "that not ten per cent of them will be recovered."

Mr. Sweet took the steel shipbuilder's view that wooden ships could not make any headway against steel vessels in economical competition and advanced some good reasons for his stand. Considering construction alone he made the point that there was such a pronounced space wastage in a wooden boat that it was very greatly at an economical disadvantage as compared to the steel ship. A steel vessel burning oil as fuel, for instance, can carry oil enough for a round trip voyage to Europe, whereas a wooden ship is obliged to stop at the Azores on its way to Europe to take on more coal.

We touched on the matter of oil for fuel and Mr. Sweet saw nothing for it in the future but the heavy oil engine ship, because an oil burner producing steam uses by weight only two-thirds of fuel oil against three-thirds of coal. With a Diesel high compression heavy oil engine, as a matter of fact, in a motor ship, the oil used by weight would be as one to three with coal. With regard to space occupied for motive power plant a still greater economy is effected by builders where the low compression heavy oil engine is employed for the propulsion of the ship. We are witnessing only the beginning of the oil engine power plant in the maritime field.

COLOR SCHEME FOR POWER HOUSE PIPING

The following list of colors for piping has been prepared by a correspondent of *Power Plant Engineering* and is presented here for whatever it may be worth. It of course has no official endorsement:

Live steam	Yellow
Exhaust steam	Black
Compressed air	Dark green
Hot water	Dark blue
Cold water	Light blue
Returns (condensation)	Gray
Fire service water	Maroon
Ammonia	Brown
Brine	Light green
Oil	Purple
Hot water heating	Pink

Harnessing the Air in Ancient and Modern Times

By CHARLES AUSTIN HIRSCHBERG

AIR, bounteously supplied by Nature and so essential to the very existence of all species of life, has like many other things been appropriated by man to impart life to many mechanical contrivances which are exercising an extensive influence on mankind's manner of living—the things we eat, the clothes we wear, our shelter and our amusements. Even modern warfare depended largely for its terribleness upon the diverting of air by man from Nature's intended purpose.

Man compressed and used air many hundred years ago. The story is older than that of Christianity itself, by about 350 to 400 years. It was contemporaneous with many ancient and long dead civilizations. It is, in fact, the oldest known motive power, exclusive of the beast and man, wind and water contrivances, so familiar to the olden days.

Alexander The Great was still undergoing his education under the tutelage of Aristotle; Persia had just attained the height of its ancient civilization; the teachings of Confucius were still comparatively new in the Land of the Manchus; Roman history was just starting, and the scourge of Attila and his Huns had not yet been visited upon the world, when the story of compressed air was first written. We read that Ctesibius of Alexandria invented an implement for war, consisting of a tube out of which an arrow was shot by the compression of air; that Heron, a pupil of Ctesibius, made various experiments with compressed air, one of them being the sustaining of a jet of water in the air.

Heron was a genius in his day, much sought after by the priests of the temples, who enlisted his aid in mystifying the ancients and causing them to believe that the priests were invested with supernatural powers. Heron applied his knowledge of the influence of heat in expanding and contracting air, to the opening and closing of the temple doors, to the blowing of organs, and in the form of the bellows, to the kindling of intense fires.

A hollow altar containing air was heated by a fire kindled on it; the air in expanding would drive some of the water, contained in the spherical vessel shown beneath the altar, into a bucket, causing it to descend and open the temple doors by turning a pair of vertical posts to which the doors were fastened. When the fire was extinguished the air would cool, the water would leave the bucket and the doors would close. So much for the ancient story.

The modern story of the first commercial work to which compressed air was applied is not very old; scarcely 70 years, as man measures time. Innumerable innovations in scientific mechanics have been developed in this comparatively brief period, such as the telegraph, the telephone, wireless, the great compound locomotive, the incandescent light, the rotary printing press, flying, the submarine, the automobile, and scores of other major inventions that no longer surprise most of us. All are of such a spectacular nature that they have not failed to produce wonder and admiration in the thoughtful—they have left a vivid impression on our minds, and yet none of them can claim a more beneficial or more lasting influence on man's welfare than can the uses of compressed air, which, working in comparative obscurity insofar as the masses of population are concerned, have performed and are still accomplishing tasks admittedly insurmountable by other means.

Few perhaps are aware that the coal with which we heat our homes is extracted from the earth by means of compressed air—that coal by-products, supplying the leavening agent for our bread, and the gas with which to bake it, the wherewith for dyeing our clothes, the basis for many of our medicines and many other things too numerous to mention, depend upon compressed air for their existence.

Compressed air pumps the water we drink, supplying it free from sulphur and other impurities. It acts as a transfer agent, handling acids and other chemicals, eliminating the element of danger to the person from many of our employments.

Compressed air mines our precious ores and gems—iron, copper, nickel, tin, zinc, lead, silver, gold, platinum and radium; the diamond, the turquoise, the ruby and many others. Not content to stop there, it works in varied ways to bring them to that state where man can apply them to the useful arts; it turns the metal into ships, buildings, bridges, locomotives, steel cars, automobiles, etc.

It cleans and renovates our houses, rugs, clothes and furs. It does our painting, it sprays our trees and shrubbery. It builds our roads, tunnels and subways, it brakes our cars and trains, making them safe for millions of folks to travel upon. The late George Westinghouse, who invented the air brake, was laughed at when he proposed to "stop a train with wind," and yet his epochal invention has proved to be one of the most important elements entering into the success of modern railroading.

Compressed air quarries our stone, and dresses it, so that we may pave our streets, face our buildings, build our monuments and trim our houses to stand through the ages as a testimonial of the industry of bygone generations.

The skyscrapers of New York owe their existence to compressed air. Such buildings weighing thousands of tons must rest on solid foundations—compressed air is the agent employed in sinking these foundations, to say nothing of its welding the thousands of rivets that bind securely their steel frame work.

Compressed air carries our mails, returns to us our change when we go shopping, pumps oil wells and conveys oil through pipe lines. It blows our cupolas and furnaces, enabling man to melt and mold metals into any desired shape. In fact, the story of harnessing the air is well nigh an unending one; name any industry and you will find compressed air there, faithfully serving mankind.

THE ATLANTIC FLIGHT

The seaplane and airplane flights across the Atlantic, which were centering the attention of the entire world, as the June issue of Compressed Air Magazine went to press, had for two years been unsafe topics on which to base any predictions. Curiously enough it had appeared to be risky to say what could not be done rather than what could be accomplished. It was unfortunate that the Navy dirigible was blown away from her moorings at Newfoundland and lost at sea, after her first fine flight from Montauk Point to Trepassey Bay, for here was lost an opportunity to compare her prospective performance with that of a trans-ocean airplane.

It may at least be safe to consider a little of the actually reliable and up-to-date information which has been made accessible.

Contrasting the airship and the airplane, it is found that with fuel carried 30 per cent of the gross weight of the machine, the ship has over three times the flying radius of the plane. This is due to the greater tractive force in proportion to weight needed by the plane than by the ship, and the moderate speed at which the airship can travel, thus reducing head resistance. The limit of a continuous flight is estimated at 1136 miles for a plane and 3430 miles for a ship under the supposed conditions.

Lanchester estimates that with a plane designed to reduce resistance to a minimum, a flight of 2000 miles might be made by a plane. As this is about the distance across the Atlantic Ocean, the conclusion is a non-stop trans-atlantic flight will only be made as a freak performance, and cannot be reduced to a regular traffic. A regular route must have at least one calling station for taking on fuel.

Further, as the atmospheric drift is always easterly, even if a continuous flight from America to Europe is made, return flight will be unattainable on account of the wind resistance.

For such air craft as would be suitable for over sea traffic, the figures are given as follows:

Airplane—Weight, 8 T.; speed 90 miles per hr.; power, 1200 hp.; fuel, 3.5 T. Running at 1000 hp. and 0.5 lb. fuel per hp. hr., will use 500 lb. an hr., and can fly 14 hr.; distance, 1260 miles. Atmospheric drift, 30 miles per hr., or 420 miles in 14 hr., hence flying east the trip could be 1680 miles.

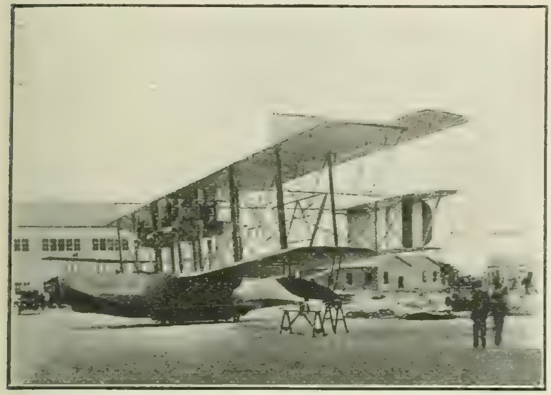
Airship—Weight, 60 T.; speed, 65 miles per hr.; power, 1500 hp.; fuel, 17 T. Using full power, fuel per hr. will be 750 lb., and can travel 45 hr.; distance, 2925 miles.

These figures would indicate that the airplane cannot, ordinarily, make a non-stop crossing of 2000 miles, while the airship might easily do so, even allowing for moderate adverse winds. If, however, the head wind rose to 40 miles per hr., it is doubtful if even the airship could make a non-stop crossing.

To show the jump from past performance in order to accomplish trans-Atlantic flight, the record for non-stop flight and perhaps the nearest to a trans-oceanic flight, was the trip London to Constantinople and back to Saloniki, when the cruiser Goeben was bombed, the distance covered being over 2000 miles and the time 31 hr. The plane was a Handley-Page with 100-ft. wing spread and 275 hp. and carried five men.

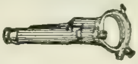
Data is not available as to performance of airships, as these have, for the most part been of German development, but it is understood that a British ship is nearing completion which has an estimated endurance of 211 hr. at 45 miles per hr., which would give a flght of 9500 miles, and that the 1918 German Zeppelins showed 177.5 hr. at 45 miles per hr., or a trip of 8000 miles. These are newspaper reports and to be taken with a grain of salt, but even with 50 per cent deduction, these aircraft should negotiate the trans-Atlantic trip easily. From St. Johns, Newfoundland, to Ireland is 1860 miles, and to the Azores is 1195 miles; from the Azores to Lisbon, 850 miles more.

A Navy "Nancy" Seaplane



(Copyright, Keystone View Co.)

This is the "NC" type of seaplane used by the United States Navy in flying from Long Island to Newfoundland and across the Atlantic. These giant planes have a wing spread of 120 feet and are propelled by four screws driven by as many Liberty motors of 400 h.p. each. They have carried 50 passengers with ease and can rise into the air weighing 14 tons, including load and make 65 knots per hour. When not heavily loaded and going at full tilt these heavier-than-air-craft can negotiate about 100 knots per hour. They can start from and alight in the water in a moderately rough sea.



INSECT PARALYZES AIR BRAKE

A motorman with excellent previous record had a collision with considerable damage. He insisted that the brake and not he was to blame. The entire braking system of the car was carefully inspected and tested and pronounced all right. The car was returned to service, but after several weeks there was another accident, and after taking everything apart, as narrated in *Electric Railway Journal,* the trouble was discovered.

In one of the passages of the triple valve there was found a collection of eggs which had been deposited there by an insect and were developing. As they spread out and grew larger, the air passing through the passage blew them into one of the ports of the triple valve. This became choked and caused the slow application of the brakes. The action of releasing the brakes, or of another application cleared the obstruction so that the equipment operated properly. Operation continued to be satisfactory until additional eggs were developed so as again to choke the port of the triple valve and prevent the passage of air.

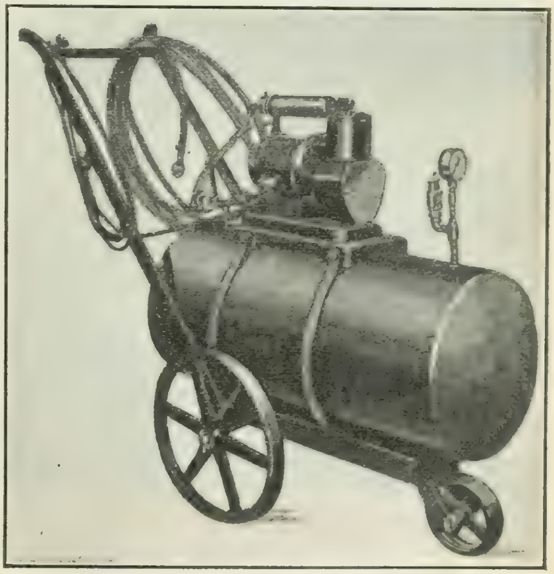
DUCTILITY OF PLATINUM

The marvelous ductility of platinum may be conceived when we consider that out of a single Troy ounce of the metal it would be possible to make an almost infinitely slender wire that would reach from Santiago, Chili, across the continent to Rio de Janeiro, a distance of about 1,800 miles. To draw out platinum into so exceedingly fine a wire it is covered with a thin layer of gold. This new wire is drawn to the thinness of the former one and the gold is dissolved.

A small section of this second wire is then given a coating of gold, redrawn, and the gold covering dissolved. After this process has been repeated several times, the wire finally obtained is still intact, but virtually invisible.

PORTABLE AIR COMPRESSOR FOR TIRES

The halftone shows a neat and compact, portable, electric driven air compressor for inflating tires, made by the Block & Decker Manufacturing Company, Baltimore. The pressed steel receiver, 14 by 30 in., holds sufficient air, it is asserted, to inflate five average tires from flat to full pressure, or ten tires from 40 to 80 lb., which of course depends upon the pressure to which the receiver is charged, and this is not stated. The compressor is operated by a ½ h.p. motor. Motor, gear train and compressor are enclosed in one housing, the motor and compressor being cooled by forced circulation of air. Motor, gears and compressor are grease lubricated.



PORTABLE AIR COMPRESSOR FOR TIRES

(Photo copyright, Keystone View Co.)

The U. S. S. Idaho, New Superdreadnought

This photograph shows the Idaho, a late addition to the navy, and one of the most powerful fighting ships in the world, riding at anchor in New York harbor. Under date of May 5, the Bureau of Construction and Repair of the Navy Department wrote the editors of COMPRESSED AIR MAGAZINE regarding the uses of compressed air on board these modern ships of war. Connections are provided at the guns for the purpose of ejecting gases generated from partly burned powder before the next charge is entered. Connections are also provided within the conning tower for expelling accumulated gases, or gases that might accumulate in battle. Compressed air, as is well known, is also used for charging torpedoes, as well as discharging them from the tubes. Ships carrying fuel oil are provided with connections in each tank, for the purpose of blowing oil from one tank to another.

In addition to the above, compressed air is furnished to the various workshops for the operation of pneumatic tools. On the fuel ship *Maumee,* which is fitted with Diesel engines, compressed air is used for the operaton of the steering gear. On big battleships such as the *Idaho* compressed air motors are installed as a reserve means of operating the hydraulic steering gear which primarily is operated by electric motors. It is also used for testing the water tightness of compartments.

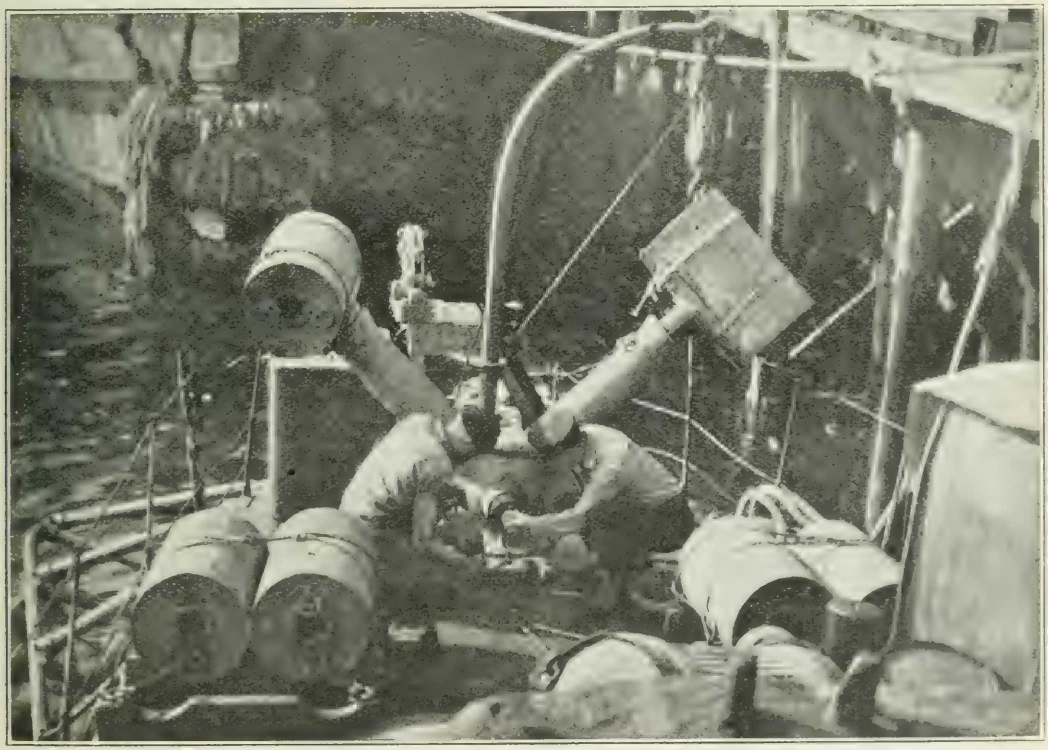
TO TEST AUTOMOBILE COMPRESSION PRESSURES

One of the most common causes of lost power in an automobile is that the force of the explosion pressure depends upon compression pressure before the gas is ignited. If the compression is 80 pounds, the explosive force acting against the piston top and imparting power to it will be about 400 pounds per square inch. If worn piston rings or leaky valves allow gas to escape when the piston is rising on its compression stroke, the resulting decrease to 50 or 60 pounds means a reduction of explosive pressure to about 300 pounds per square inch. Besides this diminution in pressure, there is a loss due to further leakage through the faulty retaining members. It is suggested by the *Scientific American* that a simple compression pressure indicating gage may be made by taking an old spark plug body, from which the porcelain has been removed and fit in a valve from a discarded inner tube by pouring melted babbit metal or solder in to fill the space between the spark plug shell and the valve. When the metal has set, the valve is found to be firmly imbedded in the soft metal. The spark plug is removed from the cylinder to be tested and the combination plug body and valve stem put in its place. As the engine is turned over briskly by either the hand-crank or self-starter by an assistant, or the engine run slowly on the other cylinders, a tire pressure recording gage held against the valve will record the compression pressure just as it does air pressure inside a tire. If the pressure is low on all cylinders it is a good indication that the entire engine needs attention. You can determine whether the compression is adequate by comparison with the same tests on a new car of the same model.

AN AIR COMPRESSOR SPEEDS UP THE AIRPLANE

A French engineer, Auguste Rateau, has invented an altitude compensation device for airplane motors. The invention comprises an arrangement by which the exhaust from the engine is made to drive a small turbine which compresses up to at least normal pressure the air drawn into the engine so that, no matter what the altitude, full power will be developed. It is stated that a heavy day bombing machine, whose speed at 15,000 feet did not ordinarily exceed 80 miles an hour, made 140 miles an hour when fitted with the Rateau device.

Milton H. Smith has been re-elected president of the Louisville & Nashville R. R., with headquarters at Louisville.



(Photo Keystone View Co.)

The Device that Ended Germany's U-Boat Operations

Here is shown the death-dealing depth bomb, or "ash can," as it was called by the gobs, and the "Y-gun" method of propelling two of them overboard simultaneously. At first depth bombs were merely tipped off a rack over the stern of a destroyer, but this was found an inconvenient and hazardous makeshift. The recoil gives a down thrust from the Y-gun, but no side thrust. By means of a regular gun breech lock, into which gunners are seen placing a charge in the illustration, a blank three-inch shell is exploded, which propels the two bombs from the gun chambers to a distance of about 30 yards from the ship. The charges, it will be noted, are lashed to T-shaped iron plungers which go overboard along with the bombs. Used by the British and American naval forces these ash cans accounted for a majority of the 205 submarine raiders destroyed during the war.

Compressed Air in the Paper Making Industry

(Photos copyrighted, Underwood & Underwood.)

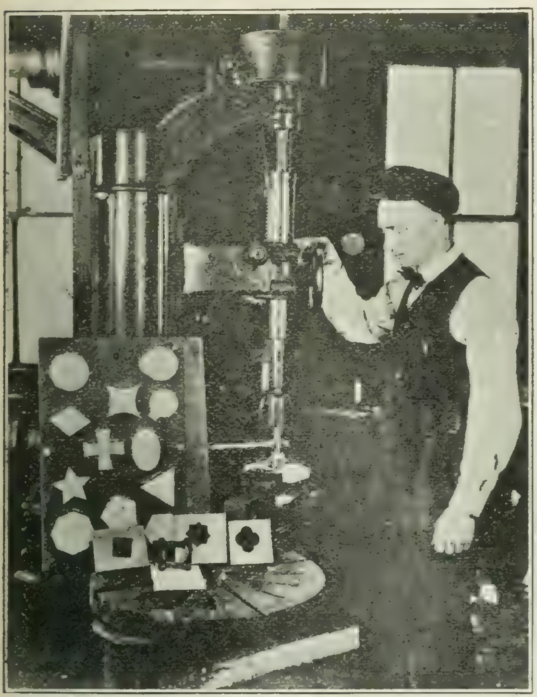
1.—WOOD BOX ON WAY FROM STEAMING BOX TO BARKING DRUM IN NEW ENGLAND MILL.
2.—DRAINING PULP VAT WITH SUCTION PIPE IN A BANGOR MILL.
3.—GENERAL VIEW OF A GREAT PAPER PLANT AT FORT EDWARD, NEW YORK.
4.—RESERVE SUPPLY OF SPRUCE FOR A PAPER CONCERN IN NEW YORK STATE.
5.—FIRST STEP IN THE PRESSING PROCESS. PULP PASSES FROM SCREENS AT LEFT TO PRESSES IN CENTER, WHICH EXTRACT WATER AND TURN OUT THICK SHEETS FROM WHICH PAPER IS MADE.

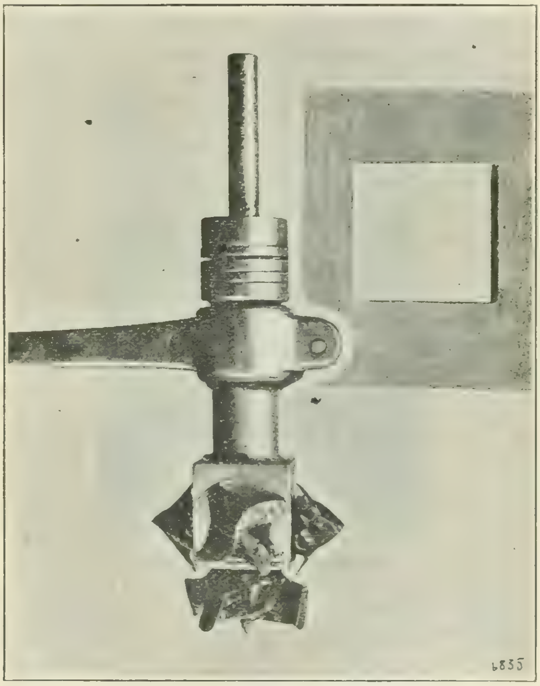
The following are uses for compressed air in a representative modern paper mill as compiled by M. C. J. Billingham in *The Paper Industry*:

Forced draft under boiler furnaces.
Induced draft in smoke stack.
Pneumatic coal and ash handling systems.
Pneumatic soot blowers.
Cooling systems for electric generators.
Air lifts for pumping water.
Hot air heating systems.

Forced ventilating systems.
Absorption systems to prevent condensation.
Absorption systems for expediting drying.
Absorption systems for drying coated paper.
Cooling systems for calender stacks.
Vacuum for suction boxes and for suction rolls.
Suction on plate screens.
Air hoists for handling paper rolls, etc.
Dust collecting systems in the dusting room.
Blower systems for washing filter beds.
Blowers for removing stock from cylinders.
Vacuum systems for sweeping the mill floors.
Portable compressors for cleaning motors.
Pneumatic tube systems for conveying written orders to the various departments.
Compressed air to assist in washing pulp.
Compressed air for agitating pulp, bleach, etc.
Blower systems for conveying sorted stock.

Mr. Billingham has indicated more than two dozen uses for compressed air in actual practice today in paper mills. Some of them are of minor importance, while others are vital. Nevertheless there is indicated a wide range of adaptations and possibilities, which are by no means exhausted. The use of air generally in the making of paper is still in the development stage and it is predicted that within a short time every paper mill will have its air piping system to convey compressed air to every part of the plant, such system becoming just as essential as the steam or water piping systems.





(Photo Keystone View Co.)

Rotary Drill that Makes Square Holes

After fourteen years of work C. H. Schmidgall, of Peoria, Ills., has become the patentee (Patent No. 1,297,740) of a device that was considered a mechanical impossibility until two years ago. Mr. Schmidgall has evolved not only a bit that will drill a square hole but all the other shaped holes shown in the picture above. The picture at the right gives a close view of his remarkable invention.

It was reported from Paris on May 10 that the French aviator, Sadi Lecointe had established the previous day what was believed to be a new height record for a monoplane by climbing 26,900 feet, or five miles skyward. He was accompanied by a representative of the French Aero Club, so the feat appears to have been authenticated for purposes of permanent record.

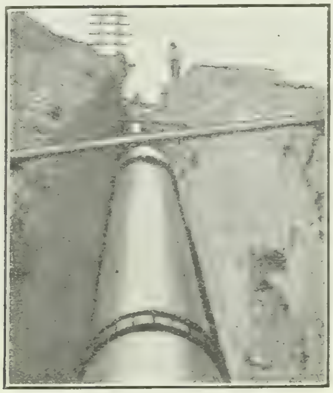
It was made public in New York recently that a woman of thirty-five who had been overcome by gas leaking from a defective jet in her home, was restored to consciousness and her life saved after Dr. Harry Rammol, an interne at Fordham Hospital, had operated a pulmotor continuously for seven and one-half hours. The case was remarkable, not alone because of the heroism of the physician's tireless work to save a life, but because as a rule a patient's heart does not stand the strain of gas poisoning and the injection thereafter of large quantities of oxygen into the lungs. Usually the shock proves fatal.

Survey of the Technical Field

Edited by FRANK RICHARDS

LARGEST GAS LINE IN U. S.

What is reported to be the largest gas line in the United States, which must mean also the largest in the world, is just being completed for the Carnegie Natural Gas Company. It is to convey gas from the coke plant of the Clairton Coke Works to the Duquesne, Homestead and Edgar Thompson steel mills. The line has a maximum diameter of 40 in., is 11 miles long, has a a daily capacity of 70,000,000 cu. ft., and is capable of sustaining a pressure of 200 lb. per square inch, although it will actually work under a pressure of from 30 to 50 lbs.

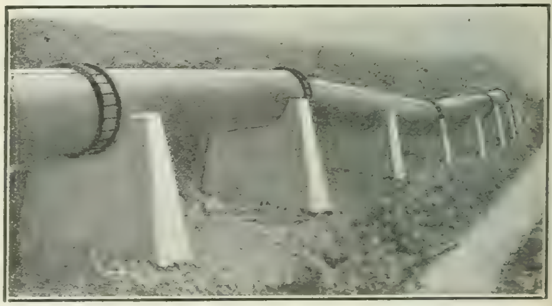


PIPE IN DEEP TRENCH.

ROUNDING SHARP CURVES.

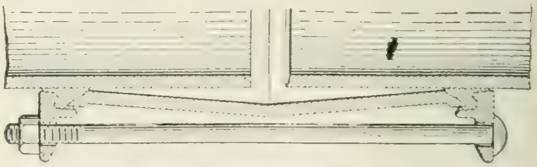
All these particulars make the installation of special interest to all who may have to do with the large transmission of compressed air. The line passes through a hilly country, the curves, both horizontal and vertical, being numerous and it is laid partly under ground and partly upon concrete piers above the surface, as seen in the illustrations here reproduced from *Engineering News Record.*

The pipe used is of the lock-bar type, with plain ends. The uniform thickness, for all sizes from 30 to 40 in. is 3-8 in. There are 38,081 ft. of 41 in.; 12,381 ft. of 36 in. and 7881 ft. of 30 in. It was necessary to use riveted pipe in certain special sections for very sharp curves and for a riser which was required at a bridge.



PIPE LAID ON CONCRETE PIERS.

The joint used is of the Custer type, with rubber gaskets, and where the curves are of large radius the play allowed by the flexibility of these joints is sufficient to make the turn. The design of the coupling is shown in the sketch. The buckle-plate sleeve which abuts against the rub-

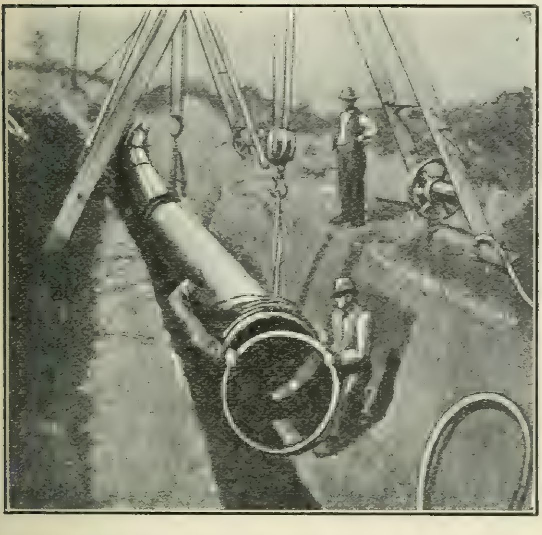


SECTION OF PIPE JOINT

ber gasket allows for an opening of from 1 in. to 1½ in. on the outside of the curves, while still maintaining a gas-tight joint. By proper beveling a curve of 133 ft. radius was laid. To round this curve, which is shown in the illustration, six 17 ft. lengths, beveled 2½ in. each end were used.

PIPE LAYING AND JOINING

It is not necessary to speak here of the trench excavation and other preparations. After the delivery of the pipe the laying is accomplished by means of tripods supporting block and tackle operated by a winch. After lowering the pipe into the trench and adjusting the joint, the back tripod is moved forward, while the forward tripod supports the end of the pipe until the insertion of the next length. In adjusting the joint the back ring is first put upon the pipe, and the rubber gasket, which fits snugly against the pipe, is snapped over it and pushed back to position in the ring groove. The buckle-plate sleeve is next inserted, after which the next length of pipe, with the forward ring and the rubber gasket already in place, is inserted in the sleeve. The ring-bolts are now placed and the nuts tightened temporarily. A 3-8 in. clearance between the ends of the pipe is allowed for expansion. After temporary placing and tightening of the bolts an auxiliary gang follows and completes this tightening, which presses the buckle-plate in against the rubber gasket, making an air tight joint.



LOWERING PIPE AND ADJUSTING JOINTS.

The T. A. Gillespie Co., of New York, was the contractor for the construction, and the lock-bar pipe was furnished by the East Jersey Pipe Corporation.

LIQUID OXYGEN EXPLOSIVES

It is not easy to believe that there can be any great future for liquid air or liquid oxygen for high explosive service. The impossibility of preventing the rapid evaporation of the liquid seems to be hopelessly fatal to its general employment. Nevertheless the subject still entices the persistent inventor and quite respectable results are recorded. *Le Genie Civile* has compiled the latest information upon this topic, and it cannot fail to be of interest to our readers.

Military necessity compelled the German authorities to requisition the entire stock of nitric explosives. Coal mines, potassium mines, stone quarries, etc., which used large quantities of these explosives were compelled to look for some substitute. This was a favorable occasion for German engineers, who for about 15 years had worked on the problem of oxyliquit, to give their products a trial in the industry. The principle of this explosive is entirely different from those upon which all the others are based. Industrial or military explosives are generally substances containing two essential constituents, a combustible element, carbon, and an ignition element, oxygen. The explosion is the result of the abrupt and violent combination of these two elements. Oxygen is introduced under the form of nitric combination or chlorinated combination; carbon in form of organic matter. With oxyliquit the liquefied oxygen is put in contact with carbon in a divided and porous form. Under a system of ignition, the combination takes place with explosion.

Liquid oxygen is always produced on the spot where it is to be used, as it is impossible to prevent volatilizaton taking place shortly. It is prepared by liquefying the air, the resulting mixture of liquefied nitrogen and oxygen, being submitted to a partial distillation, which eliminates the larger part of the nitrogen, more volatile than the oxygen. The so obtained bluish liquid contains about 85 per cent of oxygen.

A German Society for the exploitation of the Linde patents is said to be able to furnish installations giving an hourly output of 23 lb. of liquefied rectified oxygen. The liquefied oxygen is transported from the place of production to the place of utilization in special containers.

Two methods of using the liquid oxygen for blasting purposes are employed. By the "Kowastsch" method the liquid oxygen is poured upon the lampblack in the bore-hole. A cylindrical cardboard cartridge the same diameter as the hole contains the lampblack or other porous material rich in carbon. It is closed at both ends with cardboard or cork. Two small tubes of thin cardboard pierce the stopper at the outer end.

These tubes serve for the pouring of the oxygen also for the fuse or electric ignition system. A metal rod is inserted in each tube to prevent them being crushed, the cartridge placed at the bottom of the hole and packed with a wad of clay. The metal rods are then extracted and the liquid oxygen poured in by means of an elbow funnel. The explosion is comparable to that of dynamite.

The "Marsit" method allows of a more regular working and is therefore more in use than the other.

In this the cartridge is saturated before being introduced in the bore-hole. To do this the cartridges are immersed in a special vessel of cylindrical shape with double walls, filled with liquid oxygen. The cartridges are left first exposed for a few minutes to the vapors above the liquid, to cool them off, then completely immersed for half an hour. The saturation is therefore complete. When the cartridge is saturated, it is taken out, and the ignition system attached as quickly as possible; it is then placed in the bore-hole and tamped. The manipulation in this method is far simpler than in the first mentioned, the only inconvenience being the unavoidable delay between the taking out of the cartridge and the placing in the bore-hole. During the lapse of these few minutes a certain part of the oxygen of the cartridge evaporates. To lessen this loss, and to keep in the lampblack a sufficient excess of oxygen, the walls of the cartridge are made watertight; they are of corrugated cardboard. No detonator is needed to explode these cartridges, this being one of the advantages of the new method; all that is necessary is a small primer ignited by a fuse or by electricity.

The principal company manufacturing this product, the "Sprangluft Ges. m. b. H.," of Berlin, claims to have delivered each year an equivalent of 10,000 tons of nitric explosives. Even allowing for probable exaggeration, that shows how widely this product is used in Germany.

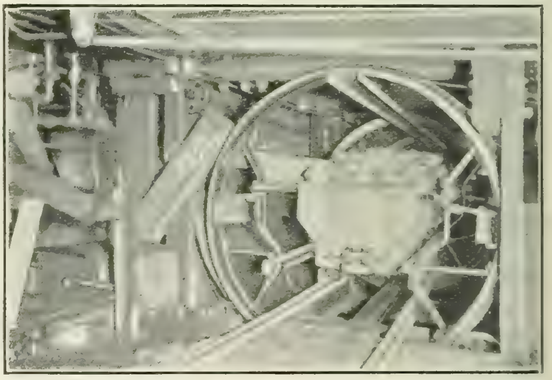
The greatest advantage of oxyliquit is that it almost entirely eliminates the danger of accidents. The cartridge itself is only explosive for about 10 minutes, between the time of its saturation and the time of its ignition. During this time the danger is not any greater than with any other explosive. The result of this advantage is that in case of a miss, it is only necessary to wait half an hour for the cartridge to become entirely harmless, and so to be able to uncover the bore-hole without any danger. In addition, all danger inherent to transportation and storage of the explosive is entirely eliminated.

The method, however, has its disadvantages. The principal is, that it is impossible to store liquid oxygen, thus requiring a liquefaction and rectifying plant at the place where it is used. Also there is need of very experienced hands for a quick charging of the boreholes.

Theoretically, the new explosive may claim superiority. In practice, however, it gives an explosion hardly equivalent to the most powerful explosives known, the common dynamite and the gelatine dynamite.

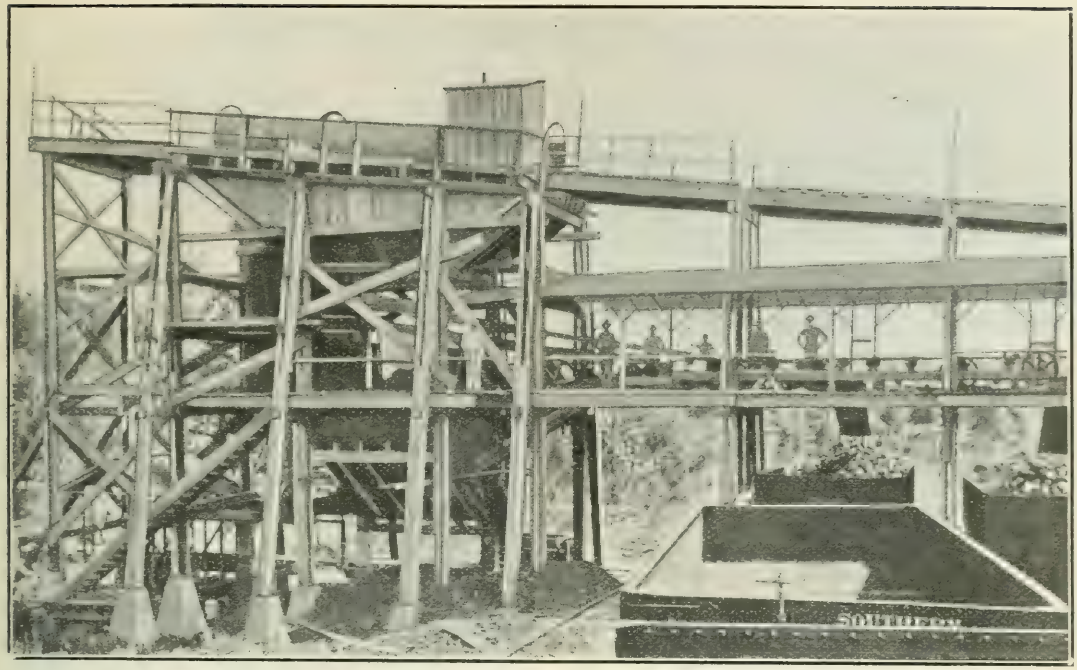
THE WOOD ROTARY PNEUMATIC DUMP DESCRIBED

We have at different times shown in Compressed Air Magazine quite a variety of devices for dumping or unloading cars by means of compressed air. These devices have generally been embodied in the construction of the individual car and have added greatly to its cost and maintenance. With the arrangement here shown, used chiefly for mine cars, the car itself is reduced to its simplest terms. There are no doors or hinged bottoms or sides to be opened or any other contrivances.



CAR IN CAGE READY TO DUMP

The cars, either singly or several at a time, are run into a revolvable cage built into the track at the dumping place, and then by rotating the cage the car is turned over bodily and its contents



Three-Car Dump on Incline Delivery

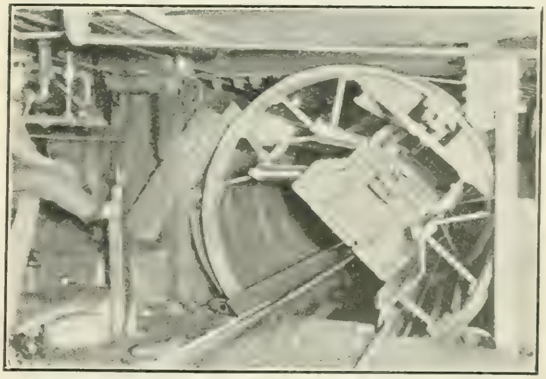
VIEW INDICATES METHOD OF DELIVERY TO TRAVELING CONVEYOR AND STANDARD RAILROAD CAR BELOW.

are dropped. The cage consists of large steel rings within which are the track for the car with the necessary guides, including overlapping projections which catch the body of the car when the rolling over occurs. The large rings are supported by flanged wheels mounted on roller bearings.

The dump is operated by two long air cylinders with the pistons attached to wire ropes running around the rings. The main cylinder for rotating the dump to unload the cars, and the reverse cylinder for returning the dump to normal position, are both controlled by a simple valve arrangement, placed between the air receiver and the cylinders, at a point convenient for the operator. In some instances the control valve is placed as much as a hundred feet away from the dump; in others it is conveniently located close by. The valve movement is very simple and the entire arrangement is so designed that any ordinary track man or driver can learn to operate the dump with very little instruction, as the cylinders are so connected that the arrangement is practically fool-proof in its working methods.

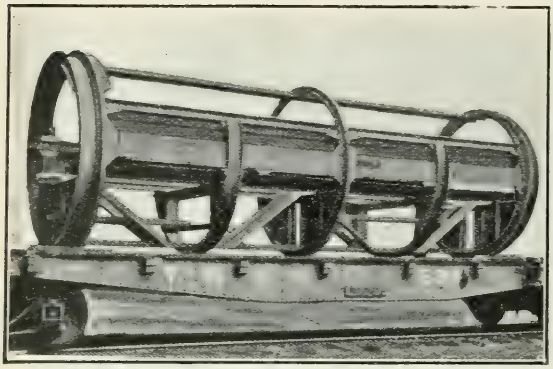
The admission of air to the main cylinder may be slow or rapid, as desired, and the speed may be varied during the rotation of the dump by simply moving the handle of the master valve. At the end of the stroke the cylinder is air cushioned, in both forward and return motions. This arrangement not only protects the car and the dump from all shocks or racking, but also assures operation with minimum power.

Where a supply of compressed air for general service is not installed only a small compressor is required, with an air receiver of sufficient capacity for a single dump.



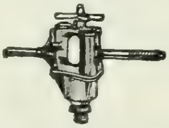
LOAD DUMP.

The illustrations are self-explanatory. The large half-tone shows a three car dump upon an incline delivering to a traveling conveyor which



DUMPING CARS FOR THREE CARS.

discharges into standard railroad cars for transportation. It is built by Wood Equipment Company, McCormick Building, Chicago.



VACUUM DRYING FOR FOOD PRESERVATION

The practice of drying food for the purposes of preservation or long distance transportation is probably older than written history. It has also been of great importance in modern times and dried meats, fish, fruits and vegetables have figured largely both in our export lists and in our domestic markets. The World War created a large and imperative demand for products so treated and gave practical impetus to the study of the processes employed and to their much needed improvement.

Dried foods, while they have been of great economic value, have always been unsatisfactory from the fact of their unpalatableness, and have generally been accepted rather as a necessity. The dehydrating processes also have too frequently failed to preserve the goods except for short periods of time.

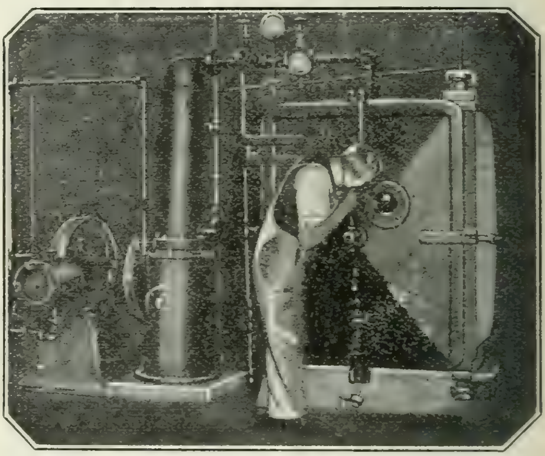
A remarkable process by which food may be preserved for unlimited periods and completely retain its original flavor and palatableness has been originated and developed at the Harriman laboratory, an institution founded by Mrs. E. H. Harriman in memory of her husband. For the account which we are here enabled to present, with also the accompanying illustrations, we are indebted chiefly to *Popular Science Monthly*.

The Harriman Laboratory here spoken of is located on the grounds of Roosevelt Hospital in New York City. It was taken over by the Government when the United States entered the World War. It devotes itself largely to discovering and rectifying the errors commonly made in food manipulation. The first instruction it received was from Lieut. Col. J. R. Murlin, of the Division of Nutrition and Food of the Medical Department, U. S. Army. He wished to know what could be done to prevent meat from spoiling without injuring its nutritive value.

The thing that causes meat to become unfit for use, unless it is cured or refrigerated, is the breaking down of its chief constituent, protein, which belongs to the same family as the white of egg. The jerked beef of the Western plains —dried for days and sometimes weeks in the sun —is so tasteless that the Indians and the Mexicans depend on red peppers to make their palates register food. The dried beef of the grocery store is treated with salt to keep it and with saltpeter to retain color. The new method does away with expensive and long-drawn-out preserving and smoking processes.

LOW TEMPERATURE VACUUM DRYING

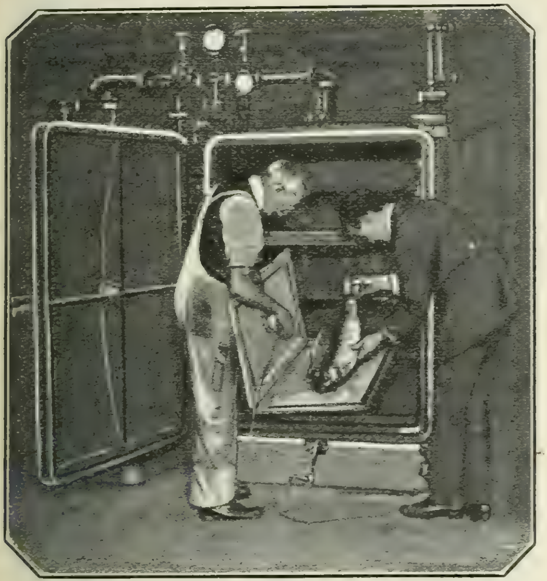
Its basic idea is the drying of the meat in a vacuum oven at so low a temperature that, after the water has been driven off, the protein and also the delicate ferments and aromas are not injured by the heat. For certain obvious reasons, the exact temperature used and other matters of the sort are for the present withheld; but the proof of the theory is in the eating, and that is found to be perfectly satisfactory.



EXTERIOR VIEW OF VACUUM DRYING APPARATUS.

If meat is to be treated it is first cut into inch cubes or in thin steaks, and laid on trays of wire netting. The trays are placed in an oven six feet square, which looks not unlike a bank safe. This oven is showed closed in Fig. 1 and open in Fig. 2. In the latter illustration will be noticed the bracing of the door to resist the atmospheric pressure when closed and under vacuum.

It will be understood that more than merly the maintenance of a vacuum is required for the dehydration process. The interior of the oven is kept at the desired temperature—somewhat warm but scarcely to be called hot—by the circulating of water through cells of piping within. The vacuum is only partial and a constant circulation of attenuated air must be maintained for carrying off the moisture. The vacuum is maintained and the low pressure air is circulated by an air pump, which might more properly be called a reversed air compressor, seen in the background at the extreme left in Fig. 1. The air as it is successively saturated with moisture from the food being dried passes out of the oven, down through the condenser and water separator at the side, then through the compressor and into the oven again, the circulation being continuous, but not necessarily rapid, as long as the drying process continues.



INTERIOR VIEW OF CHAMBER FOR VACUUM DRYING OF FOOD.

The duration of the process depends upon the size of the pieces. About ten hours are needed for such meats as beef and mutton; and from four to eight hours for fish.

H. A. Dixon, division engineer of the Canadian National Railways, with headquarters at Vancouver, B. C., has been made chief engineer of the western lines of the system, succeeding A. T. Fraser, who died recently. He will make his headquarters at Edmonton, Alta.

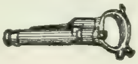
GIANT AIRSHIPS COMING

The rapidity of development of the airship seems to have fully kept pace with its speed in flight. Its dimensional growth is perhaps most marvelous of all. In 1910 the average endurance of the German rigid airship at a cruising speed was under one day, and the maximum speed about 50 miles an hour. In 1918, with the German L70 class of 2,195,000 cu. ft. capacity, the endurance at 45 miles an hour rose to 177.5 hours, and the speed to 77 miles per hour. The British R38 class, a contemporary of the German L70, has a capacity of 2,720,000 cu. ft., and an estimated cruising endurance, at 45 miles per hour, of 211 hours. In a note on the possibilities of the commercial airship, issued recently by the British Air Ministry, it is predicted that future airships will have a capacity of 10,000,000 cu. ft., a propelling apparatus of 6000 hp., and a maximum speed of 85 miles per hour. These ships would be 1000 ft. in length, 150 ft. in overall height, possess a range of 20,000 miles, and could stay aloft for three weeks without requiring refilling. The crew would consist of three officers and 26 men, and the freight capacity would be 200 tons. The cost of a 10,000,000 cu. ft. airship is estimated at between $1,000,000 and $1,500,000.

J. P. Chalmers, assistant secretary of the Empire Gas & Fuel Company, Bartlesville, Okla., has resigned to associate himself with A. J. Diescher, formerly vice-president, who recently started a new oil company at Winfield, Kansas. His old associates expressed their regrets at his leaving, wishing him good luck and presented to him as tokens of their esteem, a gold watch, gold fountain pen and handsome traveling bag.

CHEAP COMPRESSOR RIG FOR TIE TAMPERS

The San Francisco Oakland Terminal Railways, using two Ingersoll-Rand tie tampers for their track work, these tampers being estimated to require 32 cu. ft. of air per min., avoided the purchase of a regular compressor by mounting on a truck a battery of six 11 cu. ft. capacity, electric driven car brake pumps. Double capacity was installed because the old pumps could not be relied on for continuous service. The arrangement was a complete success. The tampers proved particularly successful in tamping heavy special work. On this railway the machines have allowed six men to do the work which formerly required sixteen. Of the six men one is stationed to flag vehicles while another handles the connection to the trolley wire, leaving the remaining four to do the tamping. With labor at $2.50 a day the relative costs are: Air tamping, $15; hand tamping, $40; a saving of $25 a day. The tampers paid for themselves in ten days. These tampers are also used for flat tamping of ballast in advance of concreting. They are fitted with chisels when wanted for clipping concrete and cutters when used in stripping asphalt.

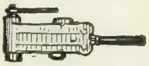


"OILINESS" OF LUBRICANTS

Before the Physical Society of London, Principal S. Skinner contributed some notes on lubrication. Experiments on the pressure of air in the neighborhood of a flywheel running in contact with a flat tangential board were described, to exhibit the properties of a compressible lubricant. A comparison of the compressibilities and viscosities of the vegetable and mineral oils led to the conclusion that the special quality of "oiliness" was the physical property of incompressibility.

Worthington's experiments on the adhesion of two solids immersed in a stretched liquid were explained as an illustration of the phenomena of lubrication in a stretched liquid. The effect of glass beads, etc., in promoting the free boiling of air-free water was explained by the occurrence of caviation behind the moving beads, etc., the steam entering the cavities thus produced and dilating them into large bubbles.

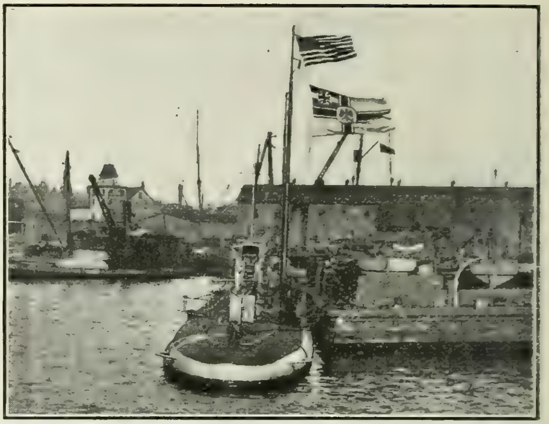
In the course of a subsequent discussion it was said that some experiments had revealed the curious fact that when working under severe conditions with imperfect lubrication, there was, for the mineral oils, a critical temperature of about 50° C. or 60° C. at which the lubrication broke down. No such temperature had yet been found with non-mineral oils.



THE SONG OF THE AIR

By *FRED GILMAN JOPP*

This is the Song of the Air—
The lifting, drifting air,
The eddying, steadying air,
The wine of its limitless space—
May it nerve us at last to dare
Even death with undaunted face.
Hey, ho! for the Air!



German U-Boat at Navy Pier

Three of the submarines surrendered by Germany became a portion of the allotment of the Kaiser's fleet now owned by the United States and have been brought to New York. The U-111, flying the U. S. Naval Ensign with the German Naval Ensign beneath, is here shown at Brooklyn Navy Yard. An American crew under Lieut. Com. Daubin brought the craft, which was disabled, safely to these shores on a subsistence for three days of pickles and jelly.

(Copyright Keystone View Co.)

Air Ships For Commercial Usage

Since the end of the war there have been startling developments in the navigation of the air and many well-kept secrets are coming to light. During the war there was hidden away in the huge buildings of the White City, London, a great factory, where over 2,000 airships, some of them more than 300 feet long, were built for navy and convoy work. Many of these "blimps" will be used for commercial purposes in the near future. In the manufacture of these dirigibles thousands of men and women were employed. The illustration above shows how the outer fabric after being cemented and sewed together is finally "doped" with a kind of varnish which dries to form a thin flexible covering, making the bag gas-tight and water-proof. The dopers, who apply the varnish with a compressed air paint brush, are protected by masks.

The Aerial Spanning of the Atlantic

By HAVELOCK C. HISLOP

AS THIS issue of COMPRESSED AIR MAGAZINE goes to press Lieut. Commander Albert C. Read and crew have won the honor of having made without interruption the most remarkable and daring journey, daring despite all its safeguards, ever attempted in an airship of any kind. The feat of the United States Navy in flying across a waste of 1,200 miles of stormy spring waters, the actual spanning of the Atlantic, will go down in history as one of the most notable achievements of man.

The world is hailing the plucky crew of aerial navigators that is about to undertake in the famous seaplane NC-4 the continuance of their trip to Portugal and England while deploring the probable fate of the courageous Australian aviator, Harry G. Hawker, pilot of the missing Sopwith transocean flyer and his navigator, Lieut. Commander Mackenzie Grieve, R. N., who with consummate daring had set off from Newfoundland for Ireland or England in a comparatively small plane from which the landing undercarriage had been dropped.

It would be premature to attempt a description in anything like authentic fashion of the aerial voyages of the three American seaplanes to the Azores. All the facts will not be in, so that the undertaking may be analyzed carefully, for weeks to come. One American plane, handicapped by a sudden blanket of fog off the Azores, was obliged to descend into a fairly rough sea, losing her wing pontoons. Her crew was rescued. Another plane came to rest on the water near her goal because of the same weather conditions, and this, the flagplane NC-1, under Commander Towers, like its sister craft in tribulation, the NC-3, was considerably damaged.

Every detail of the transatlantic flight, including the exact position of sixty-five battleships, destroyers and supply vessels, was worked out and embodied in an official order issued April 15. This was made known when "Operation Order No. 1," a document of some 5,000 words was made public after word arrived of the start of the longest leg of the flight.

Although issued a month before, not a single change was found necessary in the detailed instructions. In view of the extreme uncertainty surrounding long distance airplane flights—an uncertainty to which the British fliers who were at Newfoundland for weeks would testify—this was regarded as remarkable. In the order, which was signed by Capt. Harris Laning, Chief of Staff of the Destroyer Force, appears the following sentence:

"The start will be made early in May to get benefit of full moon on May 14 for long leg Newfoundland to Azores."

The departure from Trepassey was predicted as about one hour before sunset. The route was described as follows:

"Mercator's course from Mistaken Point to Coro (smallest and northernmost of the Azores) as a landfall, thence shortest route to Horta or Punta Delgada. the first port of landing being dependent on weather on arrival at Corvo or on some emergency arising on planes that requires landing before reaching Punta Delgada. If weather and other circumstances are favorable, landing will be at Punta Delgada, otherwise planes land at Horta, wait for good weather or completion of repairs, then proceed to Punta Delgada."

The pioneer flight of the NC seaplanes to the Azores was an achievement that put the United States Navy in the lead in aeronautics. It was well planned, courageously and skillfully carried out. Previously no land or sea plane had made a non-stop, straightaway flight of 1,000 miles. The longest continuous flight is said to have been that of Captain G. Lauriati, who traveled from Turin to Naples and return on Aug. 29, 1917, a distance of 920 miles. But it is obvious that his performance, excellent as it was, is not to be compared, for risk and audacity, for physical endurance and fortitude, with the venture of the American naval men that took them through untried atmospheric conditions and the obscurity of night hours above the surges of the perilous Atlantic to the sentinel Azores.

In its success the enterprise of the stout-hearted Americans makes a moving appeal to the imagination. Well may the Stars and Stripes be waved with elation! The American people, whose faith in their navy never falters, for never has it failed them, are proud in knowing that the service has proved to be as daring and efficient in the air as it always is on the sea, whatever the emergency. There was a thrill in the brave flight to the Azores that compensated for the rigors of the stern chase to place American aviation in the van, where it always should have been.

To regard the flight to the Azores as a feat of sportsmanship would be to misapprehend the motive and purpose of the Navy Department. The flight, planned to continue to Portugal and England, was a test of seaplane designs of the naval constructors associated with Glenn H. Curtiss, and a trial of the training, skill, and stamina of our best naval aviators, Commander Towers, Lieut. Commander Bellinger and Lieut. Commander Read and their crews. Secretary Daniels declared that the Atlantic flight had been planned for two years, but the word to stand by and get away could not be given until every detail had been carefully worked out. The navy is thorough; it does not trust to luck.

The orders were to make the trip "in the safest and sanest way." Rivalry with other services, or with any aviators flying for glory and reward, was not considered. While Commander Towers and his flotilla have done a big thing, its usefulness and the prestige of it alone concern the service and the department.

The transatlantic flight of the three NC naval seaplanes was made safer by devices employed for the first time in this enterprise. Among these were especially designed navigation instruments which enable pilots to keep their course when out of sight of land.

Three of these instruments were an aerial sextant, a drift and speed indicator and a course and distance indicator, according to a Navy Department statement which has come to our attention.

"No airplane," the statement explains, "has ever flown far enough out to sea to warrant the use of the sun, moon and stars for fixing a geographical position, as is done on seagoing ships. Navigation, therefore, on a transatlantic flight is new and untried, and it has been necessary in preparing for this flight to design three new instruments for navigational use."

A unique feature of the aerial sextant, known as the Byrd sextant, the statement continues, "is that a bubble in a tube takes the place of the sea horizon and observation. A specially constructed lens is used in sighting the bubble, which is reflected in a mirror. The sun is reflected in another mirror. The observer brings the sun tangent to a line at the same time he brings the bubble tangent to the line. That gives the altitude of the sun.

This is of especial value, as the aviator is often above the clouds, and even when flying at low altitudes the horizon is too dim to be seen clearly. With this new aerial sextant the curvature of the earth does not have to be taken into consideration in calculating position. The bubble is lighted at night, so that night observations may be taken.

"New methods of astronomical calculations also have been devised which enable the navigator to make his calculations in a fifth of the time formerly necessary. A zenithal projection chart of the Atlantic Ocean has been especially constructed for this purpose. This chart, a new invention, does away with difficult mathematical calculations, enabling the aviator to determine his position in a few minutes.

"Another great problem of the seaair navigator is the calculation of the speed and direction of the wind, both day and night. In spite of the reliability of the compass it can only give the course upon which the craft heads, and in determining the true course proper allowance must be made for the sidewise drift caused by the wind. For example, a wind blowing thirty miles an hour toward the side of the plane will allow it thirty miles an hour out of its course. This fact alone makes the navigation of the air far more difficult than the navigation of the sea.

"To overcome this difficulty bombs have been invented which ignite upon striking the surface of the water and give a dense smoke and bright light for ten minutes.

"An instrument is used in conjunction with this bomb which enables the the navigator to determine the velocity and direction of the wind by sighting on the smoke in the day time and the lights at night. This instrument, called the speed-drift indicator, has proved successful.

"When the navigator has found the speed and direction of the wind, he must then be able to calculate the course to steer toward the Azores to allow for this wind. To do this an instrument has been designed to solve the triangle of forces, thus doing away with cumbersome mathematical calculations.

"The navigator's cockpit is in the forepart of the boat and is equipped with a chart board, a chart rack and lights. He also has a specially designed headgear for telephonic communication with the pilots so that he can direct them when to change course. The noise from the four big motors is so great that it is impossible to hold conversation except with specially designed telephonic apparatus.

"The navigator also has instruments which show him the altitude of the plane and the time the sun keeps with the Greenwich meridian, because in going to the eastward so rapidly it is difficult to keep the correct time. In going from Newfoundland to the Azores over two hours is lost in a period of twenty hours, so that the navigator must be very expert in order to allow for this loss in time in making his astronomical calculations.

"In aerial navigation positions must be determined very quickly. The navigator sits down to work out his 'sights' to fix his position and will be far from his calculated position unless he works out his calculations very rapidly, which these instruments enable him to do."

From the Navy Department has been procured the following official tabultaion of the time details of the flights of the three seaplanes from Newfoundland to the Azores and vicinity. The corrected official starting time for the planes was:

NC-1—5:36 New York time, [21:36 Greenwich time.]

NC-3—6:03 New York time, [22:03 Greenwich time.]

NC-4—6:07 New York time, [22:07 Greenwich time.]

As expressed in New York time the record of the flight so far as received was as follows:

	NC-1	NC-3	NC-4
Took off, Trepassey	5:36 p. m.	6:03 p. m.	6:07 p. m.
Out of sight.......	6:30 p. m.	6:20 p. m.	6:20 p. m.
Passed No. 1	....	....	....
Passed No. 2	7:35 p. m.	7:35 p. m.	7:35 p. m.
Passed No. 3	8:03 p. m.	....	....
Passed No. 4	....	....	....
Passed No. 5	....	....	....
Passed No. 6	10:05 p. m.	10:05 p. m.	10:05 p. m.
Passed No. 7	....	10:58 p. m.	....
Passed No. 8	....	....	11:29 p. m.
Passed No. 9	....	12:10 a. m.	....
Passed No. 10	....	....	....
Passed No. 11	....	....	1:50 a. m.
Passed No. 12	....	....	....
Passed No. 13	3:13 a. m.	2:23 a. m.	....
Passed No. 14	....	....	3:06 a. m.
Passed No. 15	....	....	....
Passed No. 16	5:17 a. m.	....	4:30 a. m.
Passed No. 17	....	5:15 a. m.	....
Passed No. 18	6:14 a. m.	....	5:45 a. m.
Passed No. 19	....	....	....
Passed No. 20	8:10 a. m.	....	....
Sighted land	....	....	7:35 a. m.
Passed No. 21	....	....	....
Passed No. 22	....	....	8:10 a. m.
Arrived Horta	....	....	9:25 a. m.

I note in *The New York Times* an interesting and timely comment on the rivalry of the American and British aviators in Newfoundland and how it recalled a morning at Calais some ten years ago, in July, 1909, when Louis Bleriot astounded the world by flying across the English Channel in a frail monoplane that cost only $2,000 to build.

Bleriot, it will be remembered, had a rival in Herbert Latham, who had fallen into the sea six days earlier when as many miles from Calais, but who was game to make another start. Latham must have been a calm, philosophical person, for he was sleeping comfortably on the morning of July 25, although he knew of the presence of his rival, when Bleriot, after a feverish trial trip, rose again and launched his little monoplane out over the surface of the sea. Some one aroused Latham, and to his chagrin he saw Bleriot making off in the first gray light to win the laurel wreath which he was to wear if his engine did not stop cold again.

It was a Sunday morning, and forty minutes later early risers in Dover saw the bold Frenchman flutter down from the air after his plane was spun around twice in tricky winds. It is to be noted, because the circumstance emphasizes the skill, daring and luck of Bleriot, that Latham tried the Channel passage again and once more fell into the sea, this time near enough to Dover to give him a panoramic view of the white cliffs, the town and the surf beating at its foot.

From flying the strip of water called the English Channel to flying to the Azores illustrates the wonderful progress made in aviation in less than ten years. In 1909 it was regarded by the undiscerning as a sport with a dubious future.

Only the emergency of war roused the apathetic official mind, and then Britannia came to her senses; at the time of the armistice she had 22,000 airplanes, according to a report by the Air Minister. It was, indeed, the war that spurred inventiveness, that stimulated skill and intrepidity, until the airplane attained a measure and scope of achievement undreamed of in the experimental days when Bleriot flitted across the Channel in his flimsy monoplane.

Man after more than four hundred years of scheming and experimenting, as *The Times* notes, has learned to fly better than the eagle and the condor. All the books on the subject give Leonardo da Vinci, who was an engineer as well as a painter and sculptor, the credit of designing the first pair of wings by which biped man was to share the air with the birds; there is a print of the design dated 1500, and the books are full of queer contrivances that now excite laughter. But when the present century had dawned there were men still planning to fly by their own muscular power.

Not until the invention of the gas motor was there any hope that the planes inventors were toying with something that could be converted into a machine available for useful flight. And the gas motor had to be vastly improved before long flight was possible. The land plane suggested the seaplane, but the development of the latter, which requires a very powerful engine to lift it from the water, was slower.

A year ago W. H. Berry, in his "Aircraft in War and Commerce," made this prediction: "When the Atlantic is at last flown, an any-day possibility, it will be by a machine of this type," (the seaplane).

When the leader of our seaplane squadron neared Flores, expectant watchers must have seen one of the most astounding occurrences of any place or time. A man-driven contrivance had crossed on the wing the waters that until a few centuries ago stopped humanity. The sight was one that would have stirred any comprehending human being from the philosopher to the bushman. It was a sight to have made any of our predecessors on the earth marvel. A growing speck in a hitherto empty western sky!

As we write the first flight across the Atlantic Ocean remains to be completed. From the easternmost of the Azores to the nearest point of the European mainland stretch nearly 800 miles of sea. This has yet to be crossed, The great venture has not yet triumphed. The fliers have at least won the hardest part of the battle. The long overseas flight of some 1,200 sea miles, performed by all three without a hitch, except at the finish, exceeds all the flights over water hitherto accomplished, and its success gives promise of the full completion of the crossing.

This new victory over space as we have seen, was won by methodic preparation far more than by daring. The plans, based on close calculations, left only a minimum to chance. In so far as daring consists in taking chances these bold navigators of the air might paradoxically be called the least daring of men, for they did everything possible, or it was done in their behalf, to eliminate chances, instead of taking them. But there is a more far-reaching sort of daring, that which ventures into the new and untried, relying on the preparations that laborious prevision can furnish. To this spirit of enterprise we shall owe the capably planned airplane crossing of the Atlantic, even as we owe the reasoned and foreseeing boldness of Columbus and the imaginative practicality of Cyrus W. Field. One of these two first crossed the surface; the second spanned the bottom with his cable. Our fliers will complete the task by their transit through the air.

When the news first came that the Australian, Hawker, and the Englishman, Grieve, had soared into the air at St. John's in their frail biplane and sped away on their perilous attempt to fly the Atlantic, without patrolling ships to guide and aid them, without even a pontoon to float them if they were forced down to the sea's surface, the heart of every red-blooded man leaped in his breast.

That picture of the daring shipmates dropping the undercarriage which was used in making the start and would have served to make a landing in Ireland safe, and sweeping out to sea above the Newfoundland cliffs, resolved to do or die on the sea and take the risk of disaster if they ever reached Ireland, will live in the memory. The risk was desperate, but the spirit was the spirit that is stronger than fears of the flesh and triumphs over it, so that full success becomes of minor importance when the record is made up.

According to early but unconfirmed reports they appeared to have come nearer to accomplishing a "transatlantic flight" (the term is somewhat ambiguous) than any one else, and to have established a distance record for non-stop flying.

Somebody who has been figuring up what the voyage of the NC boats has cost, or will cost, before it is over, has arrived at the total of a round million. That is too much, and probably far too much, for to reach it there must be included the pay of all the officers and men on the many warships, big and little, that were used in the task, as well as what was spent for their fuel and general maintenance while the experiment is in progress. The salaries of these men, however, would have to be paid anyway, and there was no increment in the bills for their food.

It is true, indeed, that the expenses of ships at sea are greater than when they are in harbor, but the difference is far from being that between nothing and the cost of active cruising.

With all allowances made, the cost of the great experiment was considerable, of course. Still, it was not money wasted, nor must it all be charged up to the testing of the capacity for long ocean flights of three hydro-aeroplanes. Naval preparedness requires frequent evolutions on a large scale in time of peace, and this was an evolution or practice cruise of a highly significant and instructive kind. It involved a lot of elaborate planning to establish that long line of vessels and to keep them in it, and the success with which it was done is highly creditable.

Its results ought to be reassuring, too, as to the efficiency of our navy—if anybody needs reassurance on that point—for the plan worked out perfectly. The ships did what and all that was expected of them, that is, and the misadventures of two of the planes cannot be ascribed to anybody on the surface-going craft.

The whole undertaking, viewing it as we have endeavored to do, in its various aspects, only brings us to the conclusion that transatlantic flying as a regular matter, of course, is not so remote as most folk have imagined. Within a few years, it is confidently anticipated by aviation and dirigible ballooning experts, we shall be flying to many places that are now commonly reached by steamship and railway.

When the writer flew to the height of a mile with Roland Garros over Rio de Janeiro harbor eight years ago, he thought it a limit in aerial daring! Aviation has not yet hit its gait.

The Great Oil Industry of the Southwest

(Photos copyrighted, Underwood & Underwood.)

1.—OIL HARBOR AT PORT ARTHUR, TEX., SHOWING SEVERAL BIG TANKERS.
2.—FILLING A WHOLE TRAIN OF TANK CARS AT AN OIL LOADING RACK NEAR CUSHING, OKLA., FROM PROPERTY OF THE SINCLAIR OIL & GAS CO.
3.—STILLS (AT THE RIGHT) AND CONDENSING PLANT OF THE COSDEN OIL CO.'S REFINERY AT WEST TULSA, WHERE GASOLINE IS PRODUCED.

The great oil industry of the United States, in which compressed air has long since played such a leading part, is being subjected to an increasing demand for fuel oil for oil-burning ships. The Sinclair Company, from whose property oil is being loaded in the picture above, has lately completed a pipe line 800 miles long connecting the Oklahoma and Kansas fields with Chicago, relieving the railroads of hauling 20,000 barrels a day.

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PLATING BY COMPRESSED AIR SAVES GERMAN METALS

FOR GERMANY it was a war of struggling invention and makeshift in substitutes. The war lords had figured originally that they could beat France to her knees so quickly that conquest would be complete within a few months. Economic calculations had not covered the possibilities of the effects of failure and of a prolonged war on the German population. Many industrial plants were turned over to munitions making. As the war went on, raw materials became harder and increasingly harder to obtain. The chemists were called in consultation to substitute for almost all the necessaries the German population consumes in normal times.

There were scores of food substitutes, none of which are ever likely to achieve commercial importance, for the Teutons themselves are declared to be sick of the very sight of them! One well-informed correspondent, Samuel Crowther, of *The New York Tribune,* lately returned from Germany, declares however, that it is likely German coffee, for many years to come, will contain but little coffee and that German tobacco will consist largely of cherry leaves. It is significantly observed at the same time, incidentally, that what goes into coffee and tobacco in most countries will always be a lay mystery.

We are interested to note that Mr. Crowther observed a method of plating metals, in which compressed air was employed. This machine for plating, the correspondent declares, is very highly regarded by the Germans. The surface to be plated is cleaned with chemicals and then a thin sheet of the plating metal is blown on with a device resembling a hand torch. The torch contains a small electric furnace which reduces the plating metal to a liquid and through the connection with a tank of compressed air the molten metal is sprayed onto the surface.

By this method, gun metal, brass and copper were put on iron or steel for such parts of machines as required it, the coated metal parts being used instead of solid gun metal, brass and copper. This saved large quantities of these three products when they were exceedingly scarce in Germany.

This particular compressed air and electric furnace plating scheme is portable and declared to be most convenient in usage. It is expected by the Germans to have a permanent and wide use in the coating of ship's bottoms, tanks and other large structures where the plates cannot be plated before erection. In fact, Mr. Crowther reports, it constitutes a new variety of metal painting arrangement.

In "Compressed Air for the Metal Worker," by Charles Austin Hirschberg, New York, 1917, the author describes the recently perfected process by the German, Schoop, for applying metal coatings by spraying, indicated as occupying "a unique position in the production of non-corrosive surfaces." This process is said to be about eight years old. It is capable of depositing lead, tin, zinc, aluminum, copper, nickel and their alloys on any coherent object, whether metallic or not. The thickness of the coating is under instant control and the application can be limited to any portion of the object.

The difference between the original Schoop method and that described by Mr. Crowther is that the former involved the use of a "pistol," air at 40 lbs. pressure, a tank of hydrogen and another tank containing some reducing gas, usually oxygen, acetylene or blau-gas, the metal to be applied being liquified in flame, whereas in the latter a small electric furnace is utilized to make the metal molten before it is projected by the air pressure.

The Schoop process has been used in the United States to some extent, but is still susceptible of considerable development. Here its use is said to have been wholly for its convenience in ordinary practice and not as an ecomonical expedient such as prompted its employment in Germany during the war.

We have seen its work as applied to the coating of clay models with bronze. Here is a chance for the Italian vendors of plaster of paris "statuary" to give greater verisimilitude to their deadly work in copying bronze groups. Let us have, too, a restored Venus de Milo done in bronze veneer with both arms and do away once and for all with the icy purity of the marble replicas that wont sell because one arm is broken! On the heels of the Fiume diplomatic fiasco will there come a German-Italian *entente cordiale* through the metal-spraying pistol?

Another discovery by the Germans during the war was the making of a metal which is as light and almost as strong as aluminum by the treatment of "electron" (which was discovered just before the war) with chlorate of magnesium. This new metal was used to a considerable extent in the construction of airplanes and Zeppelins after the supply of aluminum gave out. At present this new metal is expensive, but expectations are that it will be developed.

These are indications of how chemistry and industry have coöperated in Germany during the years of war and betoken post-war possibilities. Officers of the large works at Ludwigshafen, Leverkusen and Hochst, so Mr. Crowther reports, were not so confident of the future of their industry as are most commercial Germans. The first-mentioned two works are in the territory occupied by the French and English respectively and that may have affected the viewpoint of the Germans, but the general idea of the works managers seemed to be that the progress of English and American dye manufacture, with the probability of high protective tariffs, would deprive Germany of one of her most valuable lines of export trade. It was regarded as likely that it might be found necessary to run their plants largely in the direction of finding substances which would reduce German imports. The German dye industry cannot exist without England and the United States, for at best the German textile mills can consume only a fraction of the pre-war output.

IN THE JULY issue of COMPRESSED AIR MAGAZINE there will be published a symposium on the subject of the advisability and need of the establishment of a chair of compressed air at one of America's leading universities or technical schools. All interested readers are cordially invited to express their views on this topic. The discussion will be opened by several eminent compressed air authorities and should be a topic of liveliest interest for technology educators, manufacturers of air compressors and pneumatic tools, engineers and contractors. The views of engineering students will be especially welcome. Ideas expressed for publication should be brief, not to exceed 250 words, and should be addressed to Educational Editor, Compressed Air Magazine, No. 11 Broadway, New York, before June 10.

Many of the German industrial plants are in readiness to start up again on 24 hours' notice and with their former staffs are waiting for work, which is dependent on the arrival of raw materials. The owners know they will have to pay high wages, but are declared not to be afraid of this, as they think wages in America and in England have gone higher than the German scale and that the old ratios will continue. They believe all prices everywhere will simply be marked up. In this the isolated Germans are held to have been entirely correct except as to the tense they employed. Prices have reached their apogee and are now on the descendant in most countries.

A NEW RIVETING RECORD AT FORD EAGLE PLANT

FROM the River Rouge (Mich.) Ford Eagle plant comes the news that one Vasco Miliken, formerly employed at the Highland Park plant of the Ford Motor Co., and who up to six months ago had never used a pneumatic hammer, has exceeded the world's best previous record by driving 5,542 half-inch, mushroom-head rivets in eight hours of actual working time. So much depends upon the conditions under which a riveting "record" is made, that the editors of this publication took the trouble to ascertain directly, from responsible officials of the Ford company, the facts in connection with this performance, which, to say the least, is an unusual feat.

Miliken's riveting crew consisted of himself as riveter, two buckers-up, two rivet heaters and four rivet passers, nine men in all. In addition to the eight-hour stretch of actual riveting, time was taken out for the repair of two forges and the replacement of a broken hose connection to the air hammer. According to Mr. R. J. Whiting of the Ford company, only one hammer (a Boyer No. 50 type made by the Keller Pneumatic Tool Co.) was used to drive the entire number of rivets. Air pressure at the hammer was 80 pounds. The rivet head had a crown of about three-sixteenths of an inch, which gives its kind the name of "mushroom."

All of the rivets were driven on the side shell of a boat under construction at River Rouge, and only two rivets were rejected by the government inspectors. Miliken is described as a man of medium build, being five feet, nine inches, in height and weighing 170 pounds, and is reported to have withstood with no ill effects the strain of his essay into the field of record-making. His average speed during the eight-hour journey was to drive a rivet every five seconds and a small fraction over, or allowing him six seconds to every twenty-eighth rivet.

The former riveting mark, in this country, at least, is recorded, we believe, as having been 4,700 of seven-eighths of an inch diameter, in eight hours.

Other notable riveting records, figures for which we chance to have at hand, are those of R. Farrant, who drove 4,276 half-inch rivets in nine hours on May 7, 1918, with a "Little David" riveting hammer, at the plant of Fraser & Fraser, Bromley-by-Bow, London, England, and that of William Moses, also using a "Little David" that had already been in use for a year, who drove 5,894 rivets in nine hours on May 23, 1918, at the Vickers Naval Construction Works, Barrow-in-Furness, England. The latter record was roughly at the rate of a rivet every five and one-half seconds.

In these columns, in the issue of August, 1918, Mr. Frank Richards in commenting on riveting records, which last summer were quite the fashion both at home and abroad, remarked:

"It was said of the charge of the Light Brigade that it was very brilliant, but it was not war. So without questioning at all the veracity of the current riveting records, we are tempted to say that they may be very brilliant but they are not shipbuilding, if indeed, they can be called riveting."

Riveting records that count, as Mr. Richards truly said, are the collective records per week, or other period, of all the rivets driven by all the riveters employed upon a single ship or upon a single shipyard way. This would tell us a real story of shipbuilding, and would indicate not only the riveting performance but show the co-operation of all hands to produce the desired results.

In practical, everyday shipbuilding, the riveting record does not count for much. Making a record is a "stunt," pure and simple, just as was the "building" and launching of the *Tuckahoe* in twenty-seven days at Camden. A riveting record all depends, in the first place, upon the way the stage is set, upon the preparations made for it, no matter the endurance and gameness of the riveter himself. This does not in the least detract from the credit due Miliken or any other "star" riveetr, in viewing such a feat as a sporting proposition. The fact is, however, that such speeds cannot be maintained in daily practice and that it would be foolhardy to attempt them. They do, however, serve the useful purpose of helping to set a high daily average for riveting.

In the course of the war the big shipbuilding plants encouraged record-making wholly for the purpose of showing riveting gangs what *could* humanly be done, and this served to elevate the average standard of performance. Records were kept at most of the plants on blackboards set up in some conspicuous place, and as the average Yank workman is a game animal, one gang wouldn't want to see another gang putting it in the shade!

Sawing wood or hoeing beans, either by itself is not such great sport, but if one has a wager up or there is a prize in sight, the enterprise immediately becomes a horse of another color. It is the old story of the boys whitewashing a fence, as witness the immortal Tom Sawyer's gang. They even paid Tom in marbles and other plunder for the *privilege* of whitewashing on the job he ostensibly worked upon with such supreme delectation and artistic touch! Workmen, like all of us, are just boys grown up!

HOW COMMODITY PRICES AFFECT LIBERTY BONDS

INDUSTRIAL workers by the hundreds of thousands "put over" the five Liberty Loans. Many workers have had only a hazy notion about the ins and outs of the market values of these bonds, or have been perplexed in individual cases by the below-par prices quoted when they have found it necessary to sell part of their holdings.

Thomas Gibson, financial authority and economist, discussed recently in the New York *Times* the value of the Liberty Bond as an investment, holding that it will increase as commodity prices fall. Prices generally are now very high, the index numbers showing them to be 100% higher than those of 1913. They are expected to remain fairly high; or materially above normal while the work of imperative reconstruction is proceeding, but Mr. Gibson declares it inevitable that prices of all the things money will buy will be much lower before long.

Quoting Amasa Walker, "value always expresses precisely power *in exchange*, and no other power or fact." This being true, it is obviously the case that the Liberty bonds and Victory notes will increase in value in inverse ratio to falling prices for any or all other things for which they may be exchanged, it is argued.

As an illustration it is offered that the man who owns any of the earlier issues of Government bonds can already demonstrate an increase in value between the date of his purchase and the present time. He can exchange his bonds for twice as much copper or 50% more cotton than he could have exchanged his money for at the time he invested it in bonds.

This is held as obviously true of money in any form, "but money could and can be placed in the Government issues at a higher rate of interest, considering the safety of both principal and interest, than in any other channels, not excepting the saving banks."

Unless all the economists of the first rank are wrong in their prophecies, and unless all precedents are shattered, Mr. Gibson finds, we may confidently look forward to a much lower range of prices for all classes of necessary commodities in the course of the next two or three years.

With prices doubled, roughly, over what they were in 1913, a part of this increase may, and probably will, be returned indefinitely for reasons not connected with war conditions, but the greater part of the advance will be lost.

Owners of sound bonds are certain to see their financial positions improved and their real wealth greatly increased in a comparatively short time.

While the American people for the most part did not have to be reminded of these things to make them buy of the five loan issues, it is a comforting and satisfactory reflection that they bought profitably as well as patriotically. Many people loyally purchased more bonds than they could carry in financial comfort; others found themselves unexpectedly embarrassed and obliged to liquidate their holdings; still others invested funds that were free only temporarily. As a natural result the offerings from these and other sources resulted in price concessions.

This answers the puzzled inquiries of many men and women, uninitiated in finance, as to why the bonds should decrease somewhat in market value. But another and more important cause has been the pressing demand for capital and resultant high interest rates. Security prices are more easily and more frequently affected by interest rates—the rental which can be procured for surplus funds—than by considerations affecting the future value of principal. The unusual demand for capital in war industries has kept interest rates high for years and may keep them higher than normal for a time.

There are evidences of relaxation, however, and with a release of capital, low rates for money will ensue. When the most important reconstruction work is completed, there will likely be a plethora of investment funds. This will mean low interest rates and high bond prices.

The war and the five public loans have done much for the financial consciousness of the American people. The carefully selected advertising matter used in the various Liberty loans, aside from the appeals to patriotism, have been well calculated to stimulate in us the bond buying habit, or at least saving in some form. In buying on low and favorable terms the greatest of all boons for mankind, we have simultaneously added a cubit to our stature of thrift, which is our financial strength.

NATIONAL HEALTH THROUGH THE PROGRESS OF SCIENCE

MORE and more do we depend upon the scientist to solve our economic, our industrial, our living problems. In war or in peace he is indispensable.

That renowned English scientist, Sir William Crookes, who died in April at eighty-six after his long and highly distinguished career, granted a most interesting interview only about a month before his demise. He made certain assertions that are entitled to world-wide appreciation and recognition.

As an instance, he declared that "the scientist is the real standard bearer and pioneer of industry and progress today." One of the immediate problems of science, in his view, was to effect vital economies by developing to the utmost, at the smallest expenditure of material, our capacities for generating heat, light and motive power.

He held there was no use in attempting social palliatives that were doomed to scientific disaster; that the scientist should be regarded as guide, philosopher and friend to every class in a community; that to be really good, man must be really happy, and to be happy he must be healthy. Therefore, the practical task of scientists today is to secure the nation's health. Sir William stated unequivocally that "the scientist will be the pivotal man of the world's work of tomorrow."

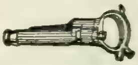
Chemists are doing a great deal for us. They are among the assuredly "pivotal" men in our country at present and are solving great problems that come with war's aftermath. The American Chemical Society, which held its annual convention at Buffalo recently, now has a membership of 12,000. There are few more important men in the world of science than these hard-working good Americans, who deserve our tribute and thanks for their tireless research to make our world a more beautiful, a more habitable, a more comfortable place.

Before the American youth sets off to college, academy, institute or university and the ever-recurrent question arises, "What shall his career be?" there must be clear thinking and the taking of competent advice in considering the highly useful professions, always taking into calculations the young man's own predilections and likings.

Engineers and chemists, good ones, are needed in our national life in increasing numbers. There is a cry now for more metallurgical specialists, who, if they have engineering ability also at their disposal, will never know an idle moment, other personal requisites being equal.

Success in such callings brings with it ample rewards, not only in material compensation, but in the warming satisfaction of having done something worth while for one's fellows.

The sciences and their professional applications point the way to health, wealth and happiness. They make for cleanliness, strength and character in national life. In them, too, lies our national security.



HOW EMPLOYEES OF INDUSTRIAL PLANTS FOUGHT INFLUENZA

THE War Department records are reported to show that the State of Pennsylvania lost more soldiers in the war than any other commonwealth. That mysterious malady called influenza, which made a virulent arrival in America last autumn, carried off more Pennsylvanians, however, than the casualties of battle and military life.

Almost every other State suffered in like ratio from the scourge that came in the trail of war, a pestilential affliction which for a time almost stopped the whirr of industry's wheels, which closed schools and theatres, which caused millions to wear germ masks, which overcrowded hospitals, enriched undertakers and wore the nerves of tired physicians and nurses to the snapping point. It was a trying time for countless thousands of patient folk, whose patriotism and good nature already had been tested severely by war's costs and restrictions.

At Easton, Pa., and across the Delaware river in Phillipsburg, N. J., where are located the large factories of the Ingersoll-Rand Company and of the A. S. Cameron Steam Pump Works, the population was confronted suddenly with a problem that could not be solved with existing hospital facilities. Hundreds of wage earners, heads and members of families in the community, were employees of the Ingersoll-Rand and Cameron plants. When a final summary was made, it was ascertained that 1448 employees had been stricken down with influenza, pneumonia, or both. The records showed that 1,091 of the several plants' working forces were absent from duty at one time.

In the emergency that arose, prompt and efficient measures had to be taken. The employees decided to convert the I-R Employees' Club House into an emergency hospital to care for the more serious cases and to make the building a centre for directing general relief measures in the vicinity. The metamorphosis was accomplished in twenty-four hours, thanks to the untiring efforts of a group of devoted men and women volunteers.

The building was equipped, filled to capacity with beds and cots, manned with a personnel and began receiving patients immediately. A kitchen and dispensary, with all other requisite apparatus were installed.

In the face of almost insurmountable difficulties a limited staff of physicians and graduate nurses was installed, but their services were augmented by the services of devoted practical nurses and assistants, and a large volunteer crew of men and women from the company's factory forces. Ambulance and fumigation service was also provided.

The organization and establishment of this hospital under the extraordinary conditions that existed was a remarkable feat in management and an unusual exhibition of resourcefulness. To express its thanks and appreciation the Ingersoll-Rand Company later issued an attractive illustrated brochure commemorating the achievements in the emergency of not only the larger Emergency Hospital, with its staff, volunteers, and friends of the company, but also in recognition of the able services of the Works First Aid Hospital.

The executives and other employees also found time to perform much emergency relief work, such as the supplying of scores of homes with fuel, in instances where members of families were incapacitated. Coal and firewood were provided, the company lending motor trucks for deliveries.

In all 165 employees participated in the relief work and 49 automobiles were employed in visiting the stricken and transporting patients and supplies, besides a fully equipped ambulance. When it is considered that 1,069 homes of employees were visited, it is apparent that this fleet of cars must have been kept busy.

The training and discipline of men and women of the working force of the Ingersoll-Rand Company showed to highest advantage in the crisis they were called upon to face and their labors of mercy and devotion reflected high credit upon themselves.

The influenza menace to employees of industrial plants throughout the country has not yet completely disappeared, and here and there have occurred sporadic outbursts. Caution must still be exercised while science continues studying to combat the disease.

GOING BACCHUS ONE BETTER

WITH the inhibition of those forms of public hospitality in which inbibing of strong drink over mahogany tops played an important part, customs and actions curious to many folk will become no doubt a part of their daily lives.

Much time was whiled away or its passage forgotten about in the temples of Bacchus and Gambrinus. This time will have to be spent somewhere, inasmuch as it is all part of eternity, which will still mysteriously claim its sections of mere time, just as worlds become star dust in illimitable space.

The economist gentlemen who glance coldly and inexorably at the passing show while displaying facts incontrovertible, inform us that the time, money, materials, energy and mayhap morals consumed as important incidentals to looking upon the liquor when it is red, will be diverted mostly to our social and business betterment. Our perspectives will be vastly changed when the rosy lenses provided by the bottoms of emptied glasses have departed into the limbo of forgotten things, we are assured. That there be a deal of truth in the observations of the social and business scientists may be adduced from the testimony of those of hardy wills, who without legal compulsion have changed over from lives in which liquor played a daily part to the calm consciousness of mental processes uninfluenced by the warmth of mounting fumes such as gave Omar Khayam inspirations in his wilderness.

Liquor in excess has made many Americans bad judges of distance. Ever try to drive a car home from the Country Club after having dallied over a few high shots at the nineteenth hole? Miscalculations have led to state laws making motoring under such conditions a penal offense. The economists assure us that a large part of our population is going to make many important decisions for itself in years to come with fewer inaccuracies of judgment and with resultant benefits, no matter the protests of those held in the grips of habit or who deplore compulsion.

Nearly every manufacturing industry in America, it is promised, will feel the effects of national prohibition, once its clutch is thrown in, and there is likely to be a general trend toward stepping on our gas. In other words, the optimists say we are pretty sure to speed up and produce more.

To aid the stricken with philosophy, any habit may be broken, given the aid of will power and science, aver prohibition proponents. In any event, as the ultimate recourse, death will come, heroic as may seem this solution by dissolution. And those who can be cured without being killed, but who lug mellowed memories with them into a drought of declining years, will find other engrossing diversions to think about —in time.

One is prompted to these reflections by the approach apace of the dry spell and by an announcement that comes to our desk out of that roaring young behemoth of cities, Chicago. We are on the eve of a period of exploiting substitutes, it seems.

Prohibition is one of the several things that have affected the beverage industries to such an extent in this year of grace, 1919, that a "Beverage Exposition" at the Coliseum in Chicago is to be held from Nov. 1 to 9. The prospectus of this unusual exposition states almost unnecessarily that this year "marks an epoch in the drink business," which is to be modified radically by "the prospective stoppage of the alcoholic drink industries."

The promoters declare the "public will stand bewildered by the novel condition and will search for new beverages that will be satisfactory. The bottlers and other retailers and the jobbers will be on the lookout for novelties in beverages that have the promise of stability in the market. The producers of beverages will be inquiring into the most efficient methods and machinery of manufacture. Food officials will be examining the new arrivals among beverages as to their wholesomeness and legality."

The exposition arrangements contemplate:

Exhibits of all types of beverages in use by the American people.

Samples of the materials employed in the production of beverages.

Machinery, implements, apparatus and devices used in the preparation of beverages.

Illustrations of the production of materials for beverages; e. g., tea plantations, dairy farms, fruit orchards, cocoa palms, mineral water wells, vineyards, etc.

Educational exhibits by agricultural experiment stations and colleges, public food and health bureaus, etc.

Exhibits of trade and technical publications.

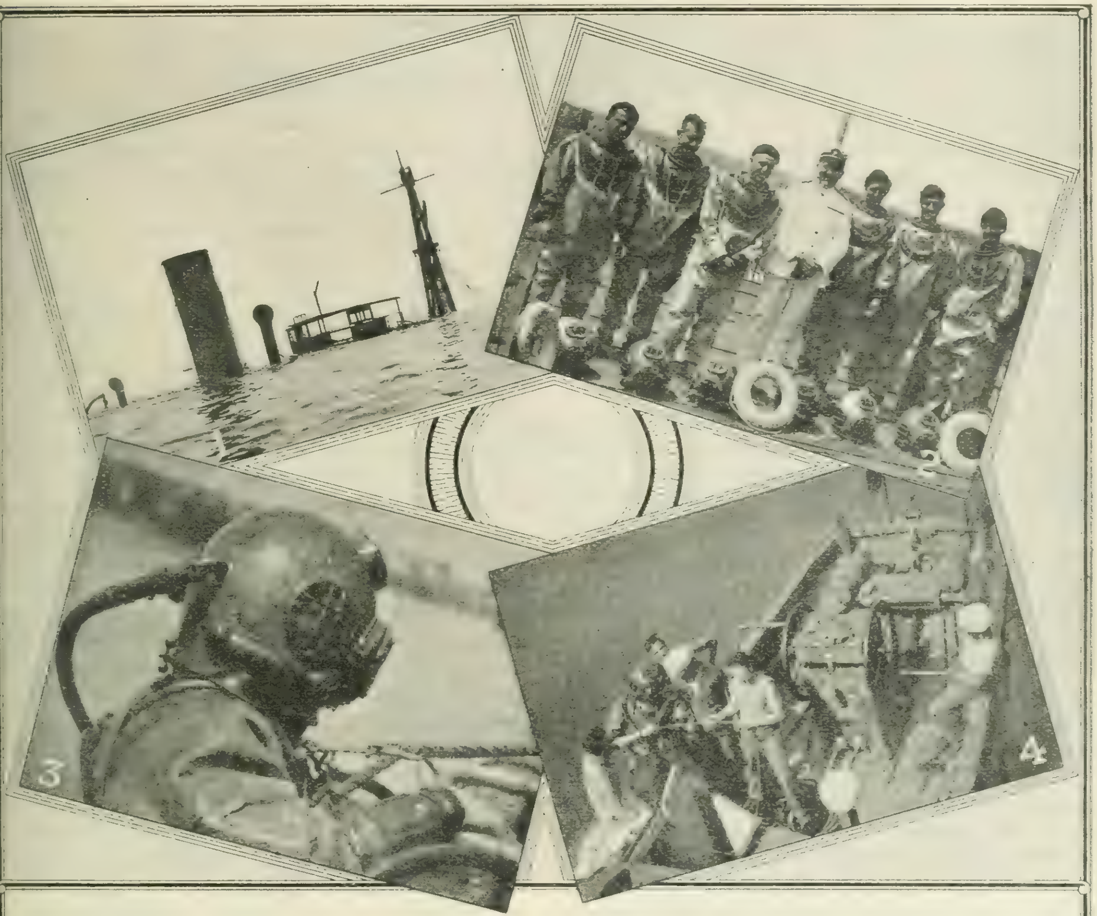
It is interesting to note that the so-called Beverage Exposition is being promoted by the men who arranged and managed the American Exposition of Brewing Machinery, Materials and Products in 1911.

A London correspondent of the Associated Press reports that an English manufacturing company has announced that it is preparing to put on the market an automobile that can be retailed for $250 or $300. The principal material in the new flivver is to be a substance not named, but which is described as "a kind of concrete, light, but strong and durable, produced from waste material such as slag, clinkers and sawdust, and covered with a metal solution." All parts, including wheels and chassis, will be stamped out, each complete in one piece, and then fitted together. Very little wood will be used in the car, and little steel, except that requisite for the power plant and transmission. The new material, we judge, will be stamped out under heavy pressure. It suggests that the day may come when in America, with our remarkable industrial production methods, we may be able to evolve a small, light, practicable car to cost less than a motor-cycle. If the day ever comes when this car is an actual fact, and it has been much debated, the Henry Ford millenium may arrive, in which half the world will be riding in flivvers and the other half dodging 'em.

The well known Mr. Sic Semper Fidelis softly suggests in a letter to the editor of the New York *Sun* that bottles of fluid from the Brandywine River be used for the christening of war vessels at launchings after July 1. Report received and laid upon the -uh, uh- bar of naval opinion, as it were, for future action.

Charles F. Thompson, president of the Western Golf Association, boldly essays the opinion that "business is the ruin of the golfing man," and then observes, "What's the use of making money anyway? The caddies get it all eventually."

Diving Squads New Branch of the Navy



(Keystone View Co. from official photos.)

1.—SUNKEN CRAFT BEING SALVAGED BY NAVY DIVERS.
2.—CREW OF DIVING LAUNCH NO. 2 LINED UP ON DECK.
3.—NEAR VIEW OF A DIVER'S HELMET, SHOWING COMPRESSED AIR HOSE CONNECTION.
4.—DIVER AFTER BEING SUBMERGED OVER TWENTY MINUTES COMES UP TO REPORT EXTENT OF DAMAGE.

A new branch of the Navy has been developed, as an outcropping of the war, the duties of which are to salvage government vessels and to repair transports, battleships, submarines and other craft injured below the water line. Hundreds of expert divers have been trained to engage in this work, which is an uncomfortable and sometimes dangerous duty. During the war, the Navy maintained at least one of these men aboard every battleship and destroyer. When a ship was damaged through accident or torpedo a diver was sent underwater to ascertain what repairs were necessary. Many are now engaged in raising ships or in ascertaining whether they can be raised. When a diver remains below the surface more than fifteen minutes he is credited with additional pay of $1.20. When submerging he is equipped with 50-pound shoes and has a weight of 100 pounds of lead about his waist. This is to steady him against ocean currents while at work. Vew No. 4 shows how air at low compression is supplied to the diver from the surface.

Lieut.-Col. H. S. Crocker, at a dinner in his honor given at the Denver Athletic Club jointly by the American Institute of Electrical Engineers and Colorado Association of Members of the American Society of Civil Engineers, addressed these friends on the construction of the U. S. Army Supply Base at Brooklyn, N. Y., one of the largest of army engineering projects.

Books and Writers

In the Realm of Science as Applied to Industry

NOTE.—*The Editors will be glad to review in these columns American or European works under these classifications:*

Engineering; chemistry; general machinery; compressed air and its varied applications; pneumatic tools; general scientific subjects; inventions and interesting patents; maritime affairs and shipbuilding; foreign trade; international relations; industrial topics, including power, coal and steel; electricity and its applications; railroads and transportation problems; oil and gas and related matters; aviation and aerial transport; mining, minerals, metals and metallurgy.

Works submitted for review should be addressed to "Books and Writers" Editor, Compressed Air Magazine, 11 Broadway, New York, U. S. A.

GEORGE WESTINGHOUSE; HIS LIFE AND ACHIEVEMENTS, by Francis E. Leupp. Illustrated from photographs, with photogravure portrait. Boston: Little, Brown, & Company. Price, $3 net.

IN THESE columns, in January, 1911, there was published an account of one of the most notable of the public utterances of Mr. George Westinghouse, his own description of his invention of the airbrake, which was given in the course of an address he delivered at the annual meeting of the American Society of Mechanical Engineers. In our issue of April, 1914, it was our duty to pay an editorial tribute to the memory of the eminent engineer who had just passed to the beyond. The career and example of Mr. Westinghouse have furnished inspiration for so many engineers, and so many of the more intimate details have been hidden from the public, that there will be a hearty welcome for the new "Life" by Mr. Leupp from the press of Messrs. Little, Brown & Co.

It has been our genuine pleasure to scan the pages of this romantic story of the achievements of one of the greatest benefactors of the civilized world, which affords sidelights hitherto unseen. One of the foremost of American inventors, his first creation being a rotary engine at the age of fifteen, he was best known, of course, as the inventor of the automatic air brake, although his automatic railway signal occupies an equally important position as a safeguard to modern high-speed railroading. He was a pioneer, in the face of determined opposition, in introducing into America the alternating current machinery which has rendered possible the transmission of electric power for long distances, and enabled our engineers to utilize valuable watercourses which formerly ran to waste.

Mr. Leupp hopes that one day some eminent expert in technology will prepare "an adequate summary of what the whole world's industrial advancement owes to the tireless energy of Westinghouse," the mission of his own volume, as he puts it, being "simply human." Nevertheless the author, by his industry, has afforded us an excellent picture of the inventor, his work, his aspirations, his achievements. Even as the author hopes, he has conveyed to the young man of today a sense that his career will depend for success less on the splendor of its start than on the spirit in which he pursues it; far less on capital than on courage, on worry than on watchfulness, on "pull" than on persistence.

The inventor left no diaries, no files of personal correspondence and scarcely any other sources of supply for a biographer, Mr. Leupp relates, and he was obliged to rely largely on his own social acquaintance with the subject of his book, and on other friends of Mr. Westinghouse, local tradition in neighborhoods where he lived, records of courts and minutes of public meetings, partnership account books and corporate reports, in collecting his materials.

Westinghouse was born on Oct. 6, 1846, at the village of Central Bridge, N. Y., on a day when his mother had refrained from mentioning the impending event, as her husband had worked all the night before on an invention which also kept him completely absorbed in his shop all of the day when his seventh child first saw the light. The father achieved a mechanical triumph as an inventor simultaneously with the advent into the world of the child who was to bear his name and enhance it by a lasting fame.

George Westinghouse, Jr., it is to be noted, early betrayed signs of being a "chip of the old block." It was a task to keep him at his studies and he preferred of all places his father's shop, in the mysteries and delights of which he revelled.

The neighbors regarded him ("with an air of pity and wondered what was to become of so ill-promising a boy when he grew up.") Feeling any strong desire he would not brook the slightest opposition to his efforts to gratify it. Occasionally he would refuse to go to school, but would stubbornly stretch himself on the grass somewhere, and play for hours with pieces of wood, whittling them into mechanical shapes and pivoting them together with bent pins, so that they would interplay like the jointed members of a piece of machinery."

When balked the boy would fly into a rage terrifying to behold. Old neighbors of the family still remember these paroxysms, which took the form first of screaming and stamping, and then of throwing himself flat and banging his head against any hard surface that came most convenient. If those about him became obdurate he would keep up the disturbance until his strength was utterly exhausted. Usually, however, the older members of the household, unable to edure the demonstration longer, would yield the point at issue, and his tears, cries and self-torture would cease as suddenly as they had begun.

In later years, Mr. Westinghouse himself, in recalling these outbursts, remarked with whimsical humor that he had a fixed notion that what he wanted he must have. "Somehow, that idea has not entirely deserted me throughout my life. I have always known what I wanted, and how to get it. As a child, I got it by tantrums; in mature years, by hard work."

Mr. Westinghouse, Senior, moved his business to Schenectady in 1856, two partners joined him in his machinery business and the firm bought a building once used as a cement mill, on the south bank of the Erie Canal, which was turned into a shop. The main part of this is still standing and one can trace from a neighboring elevation what the elements have left of the old sign, "G. Westinghouse & Co." Young George was sent to school but did not expand mentally as his father had hoped. In spare time his father had him come into the shop and learn how tools were used by skilled hands. When watching his brother handling metal parts he would criticize and precipitate violent controversies; if left to himself at a bench, with a pattern, materials and tools at hand, his attention would soon wander and he would become immersed in some mechanism of his own contriving.

The father would occasionally gather up the "trumpery" of a little engine, a miniature water wheel and other creations and consign them all to the scrap heap. But one day when Mr. Westinghouse had thrown out an apparatus on which young George had shown more than ordinary ingenuity, a good-natured and sympathetic foreman stayed after closing time, without his employer's knowledge, and fitted up a den in the loft of the building, which was turned over to George for an amateur workshop, where the young inventor passed many happy hours. Here he designed and built his model for a rotary engine.

After a year or so he struck a bargain with his father who agreed to pay him at the rate of fifty cents a day for the time he put in at the shop. This was his first paid "job." One day when he wished to play with companions and had work to do, he rigged up a combination of tools which, attached to a power machine, would feed the pipe and automatically do the cutting he otherwise would have had to do by hand. While naturally gratified at this display of inventive ability in his son, Mr. Westinghouse became almost hopeless of converting so volatile a boy into a steady mechanic.

The youth tried to run away to enlist as a soldier in the Union Army, but was caught on board a departing train by his father just before the conductor gave the signal to go ahead and sent ignominiously back to school. His father thought the war would be over in a few months. By the summer of 1862 the situation had changed, and the boy, now nearly seventeen, reopened the subject, his father observing, "perhaps you are right, my son," and the matter was arranged. He had ambitions for a "commission" and wound up at an army recruiting office in New York where an officer gravely heard his desires. He got a gun and knapsack and a thirty-day enlistment trial, after which he insisted he was of officer calibre through experience. He was told he could have a commission if he would recruit fifty men in his own neighborhood. He only got seventeen, however, and went back into the struggle as a private becoming a corporal in the New York volunteer cavalry.

But his real desire was to get into the navy in the engineering service and on Dec. 1, 1864, by virtue of his military training and earlier mechanical training, he got a berth as Acting Third Assistant Engineer on board the *Muscoota*. Later he served in the *Stars and Stripes*, and in the Potomac flotilla. The next year he came home, the war ended, and his father was pleased to note his increased manliness. He went to work at $2 a day for his father, not long after married, and soon his opportunity came.

Young Westinghouse for some time had seen the need for an efficient railway brake. His first idea was to work it by steam, but he was obliged to give up this idea because of physical obstacles and legal reasons. One day he bought from a young woman a copy of a magazine which described drilling by compressed air in a European mine, the air being piped 3,000 feet to the drills. Eureka! Here was the answer to his problem.

Then began his struggle. He designed a working model and tried to interest railroads in it, but with small success at first. His father declined to finance him. Eventually the Panhandle Railroad and the Pennsylvania came to agree with him on the practicability of his invention and he obtained moral and financial support from new friends in Pittsburgh. A half-million dollar company was formed of which he was president, a heavy responsibility for so young a man. In those days a company with such a capitalization was regarded as a very large undertaking.

Mr. Leupp takes us through all the stages of Mr. Westinghouse's triumphs at home and abroad, the adoption of his brake as standard equipment in America and Europe. It is a fascinating tale of human achievement and it would wrong the prospective reader of this book to tell him in advance the details of how Westinghouse won his way. His later development of the natural gas industry in Pittsburgh and its effects on that seat of manufacturing, his entry into the electrical field, his struggles in New York, the origin of the "stopper" lamp, and other momentous events in his life up to the closing scenes in 1914, are related with compelling interest.

Faulty springs in a limousine led to his taking up the matter of air springs, and an invention by Richard Liebau, a machinist of Watervliet, coming to his attention, he joined forces with Liebau, perfected the device, profitably marketed it, and left it behind him as one of his less-known enterprises.

The Rev. Dr. Samuel J. Fisher, of Pittsburgh, in his funeral sermon at the Fifth Avenue Presbyterian Church, New York, quoted the lines:

I know the night is near at hand;
The mist lies low on sea and bay;
The autumn leaves go drifting by;
But I have had my day.

George Westinghouse had had his day! He had filled every hour of it with achievement, as his biographer truly says, and the sun when it set saw him still at work. He was one of the most notable Americans of his time—a true captain of industry.

LAYING DOWN AND TAKING OFF, by Charles Desmond, author of "Naval Architecture Simplified," and "Wooden Ship Building." Illustrated. New York: The Rudder Publishing Company. Price, $2 net.

Mr. Desmond's book is the result of a series of articles published in *The Rudder*, which became so popular that the demand for copies soon exceeded the supply. It was thereupon decided to issue the materials contained in the articles in book form, with illustrations. The articles originally published came about as a result of the fact that there were so few men understanding mould loft work at the time the urgent call for ships came at the beginning of America's participation in the war.

The writer indicates that he is thoroughly versed in the subject; he has an unusual faculty of imparting his knowledge in a simple, understandable way that the reader easily grasps. The book is intended for the man who does not know, who wants to acquire the necessary knowledge and who has found most previous treatises on the subject a struggle in "the dark, void space of theory."

THE AMERICAN AIR SERVICE, by Arthur Sweetser, Sometime Captain, Air Service, United States Army, with an introduction by Newton D. Baker, Secretary of War. Illustrated from photographs. New York: D. Appleton & Company. Price, $2.50 net.

Secretary Baker in his introduction to this book, which is by no means an apology for the American aviator and his deeds of accomplishment, declares that the greatest value of the volume will lies in the fact that it is an authoritative statement of the present state of the conquest of the air. The necessities of war speeded the development of aircraft enormously. "Ten times as many years would not have produced the same advance if the years had been devoted to peaceful pursuits and commercial uses of airplanes had been the only incentive to inventors and producers. With the start now made, however, it is difficult to restrain one's forecast of the possibilities of the immediate future."

Mr. Baker's is a temperate statement of the possibilities and actualities we may expect in aviation in the next few years. The imagination, as he says, leaps at the possibilities of these developments. We cannot foresee or foretell what services these new wonders are to render to mankind. Opportunities are limitless, but as yet we can only stand by the wayside and exclaim as they go by: "My father, my father, the chariots of Israel and the horsemen thereof!"

For the first time Capt. Sweetser has given us the whole story of American military aviation, which has been largely dependent, of course, on the advancement of commercial aviation. The book covers every phase of our war programme and contains many facts new to the public, including hitherto unpublished figures, cablegrams and other data.

Beginning with the early experiments of Langley, Capt. Sweetser traces briefly the development of aviation in America up to the entry of the United States into the war. He then shows how the Air Service was first projected as an arm of the military establishment proportioned to the other arms, and how, in response to requests from the Allies, the programme was later expanded into an attempt to create an immense independent striking force, which should not only give the supremacy of the air to the Allies, but should also constitute America's greatest contribution to their military strength.

The author then considers the separate problems of the training of the fliers, the training of the great ground forces, the production of engines, culminating in the development of the Liberty Motor, and the development of plane construction, first bringing the story down to the disruption of the air Service and the new start after "the storm of May, 1918."

At this point Capt. Sweetser examines the real meaning of the programme upon which the United States had embarked and shows its essential impossibilities. The narrative is carried forward to the signing of the armistice, not only in training and aircraft production at home but in the actual work of the Air Service overseas.

The exceedingly interesting concluding chapters deal with the work of the fliers in the United States, including the establishment of the Air Mail Service, the organization of the Air Service in France, and the achievements of the American aviators and balloon men at the front.

The author's valuable contribution to aviation literature will have an appeal for the layman as well as the aviator and will stand as a work of historical value to which all future writers will be obliged to refer. It is carefully indexed for the guidance of those seeking references to particular subjects and will prove of great value to those concerned with dates and facts. It bristles with figures and data to be found in no other work on the subject that has come to our attention.

PUMPING MACHINERY, a Treatise on the History, Design, Construction and Operation of Various Forms of Pumps, by Arthur M. Greene, Jr., Professor of Mechanical Engineering, Russell Sage Foundation, Rensselaer Polytechnic Institute; Sometime Junior Dean, School of Engineering, University of Missouri. Illustrated. Second edition, revised. 8vo, vi-703 pages, 504 figures. Price, cloth, $4 net.

Professor Greene delivered some seven years ago a course of lectures to the mechanical engineering students at the University of Missouri, which has become the basis for an excellent book covering the field of pumps much as he had mapped out his original student's course. The author's general plan in the work is to give a brief historical outline of the pump, one of the oldest machines known to man, and which latterly has been closely connected with the history of the steam engine, following this with an examination and description of the action of a number of common forms of pumps, showing methods of design.

This book is primarily suited to the use of those who have studied hydraulics, mechanics, and the strength of materials. Its announced purpose is to develop certain general principles of mechanics which are applicable to pumping machinery, as well as to train the student in application of certain of the theoretical portions of the studies of an engineering course.

The two opening chapters are devoted to the development of pumping machinery, since the author feels that all engineers need a more intimate knowledge of the early members of his profession. The pump is so closely allied with the steam engine in early times that this history traces the early forms of that machine. Descriptive chapters on modern pumps have been prepared from the catalogues and bulletins of manufacturers and from current technical literature.

Professor Greene's painstaking work forms for the student a reference book which will not only give him the peculiarities of the different forms of special pumps, but the dimensions and other data by which he may know what size of pump may be had for a certain purpose. Modern reciprocating pumps and simplex pumps are described in considerable detail, together with tests of pumping engines.

The author devotes a chapter to air-lift pumps and pneumatic pumps which readers of COMPRESSED AIR MAGAZINE will find of especial value and interest. Centrifugal and mine pumps are considered in the closing chapters. James P. Frizell patented the air lift pump in 1880 and Pohle took out a patent in 1886, although these two, as the author notes, were by no means the first records of this type of pump. The air-lift chapter is illustrated with drawings and mathematical formulae for the guidance of the reader.

The entire work, revised in this second edition, is one that will readily commend itself to students, instructors and to those interested in general pump practice.

THE SHIPBUILDING INDUSTRY, by Roy Willmarth Kelly, Director, Harvard Bureau of Vocational Guidance, author of "Hiring the Worker," and Frederick J. Allen. Assistant Director, Harvard

Bureau of Vocational Guidance, author of "The Shoe Industry." With an introduction by Charles M. Schwab. Boston and New York: Houghton Mifflin Company. Illustrated. Price, $3 net.

BEFORE the Great War, the United States was almost a nonentity among the maritime nations. We carried millions of tons of freight annually in our own ships, but these vessels plied the waters of the Great Lakes. We had only a hand full of ships on the high seas. When we entered the war Germany scoffed at us. Her military leaders declared we could not muster more than a few thousand capable shipyard workers, that we had no plants worth mentioning and that it would be many years before we could produce enough ships to make a dent as a contender in the war.

Looking at us from the enemy's viewpoint these indictments of unpreparedness appeared to be true. From our own standpoint they were too true for comfort. But we did not know our own strength in the industries, in powers for fast organization, in illimitable energy to produce under pressure. Much less did a blind, stubborn and cynical enemy realize our inherent strength. A hasty survey of the possibilities as to shipyard workers that might be mustered seemed to indicate that there might be available some 50,000 men, more or less skilled, for this purpose. But when we had gotten busy in overalls we had 500,000 men at work on ships!

Great Britain and Germany were the shipbuilding leaders before the war. The United States can now almost equal the output of Britain and Germany combined. We are the world's leader in shipbuilding, or at least have the equipment to be. In addition, we are rapidly on the way to being the world's leading maritime power.

How this has all come about is narrated graphically in a Houghton Mifflin book, "The Shipbuilding Industry," written by Messrs. Kelly and Allen, an authoritative work compiled as to its stated facts with the assistance of the U. S. Shipping Board and prefaced by a brief introduction from the pen of Mr. Charles M. Schwab. The book was published last year, but to this time it had not been our privilege to read it. It tells the governing circumstances that pertained to the crucial problem of tonnage, and shows how we won the race with the German U-boat, an achievement of which all America is proud.

The authors without exaggeration state that the future of civilization depended upon the success of the most tremendous industrial movement the world ever knew, carried on under the leadership of one of the most forceful of American captains of industry, and backed by the resources of the world's richest and potentially most powerful nation. The entire narrative, from the apparently almost hopeless and desperate beginning of our new shipbuilding industry, to the time of its actual achievements, is told interestingly and with authority. A knowledge of the facts this notable book contains is highly desirable for every American who wishes to see his country maintain her position in ship construction and ship owning.

GAS, GASOLINE AND OIL ENGINES, by A. Frederick Collins. Illustrated. New York: D. Appleton & Company. Price, $1.25 net.

Mr. Collins has turned out a decidedly utilitarian volume, which is a necessary work for those using engines, no matter of what type, and it is a helpful guide to anyone who wants to know what kind of engine to buy for a given purpose. The work tells the reader almost anything he wishes to know about engines, from the *barrel* of the earliest cannon to the present day high-powered engines of various types. It answers questions and conjures up things to which you have doubtless never even given thought.

In his customary easy-flowing style, the author shows just how engines are made and how to use and repair them. The theory of internal combustion is clearly explained. Gas, gasoline, oil and Diesel engines are then taken up, followed by a discussion of the uses and possibilities of the cylinder-fired engine.

One of the most valuable portions of the book is that which is devoted to engine economy. Helpful instructions are given here on how to save fuel, how to tell the different "diseases" to which an engine is subject and what treatment to use in each case. Power transmission is also treated clearly and interestingly.

We are glad to commend Mr. Collins' handy volume, which should have a place on the book shelf of every engine man.

We are in receipt of the first issue of *Du Pont Products,* a new monthly review of the du Pont activities, which is for distribution in foreign markets. This publication, a monthly, of which C. de Cordero is the managing editor, is published at No. 120, Broadway, New York, its subscription price being one dollar a year. The letterpress and illustrations are handsome and effective and the text of the initial number contains a highly interesting history of the du Pont company. Attractively described are a number of the bi-products of the great du Pont factories, together with suggestions respecting their uses. This newcomer in the field of export business literature is an apparently worthy evidence of the traditions of the great house behind it.

In a world of print where the types too frequently play pranks, there is noted atop the book review column of our neighbor, *The Literary Digest*:

RECENT FRICTION

Franklin P. Adams, of *The Tribune,* hitting on this linotype lapse, declares *The Digest* has carried its spelling reform far enough!

—F. J. T.

PUBLICATIONS RECEIVED

THE SHIPBUILDING INDUSTRY, by Roy Willmarth Kelly and Frederick J. Allen, with an introduction by Charles M. Schwab. Boston and New York: Houghton Mifflin Company. See review.

PUMPING MACHINERY, by Arthur M. Greene, Jr. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. See review.

PRICES DURING THE WAR AND THE READJUSTMENT PERIOD, by T. S. Holden. Issued by the U. S. Department of Labor Information and Education Service, through its Division of Public Works and Construction Developments. Reprint of an address before the New York Chapter of the American Institute of Architects. Washington: Government Printing Office.

GEORGE WESTINGHOUSE; HIS LIFE AND ACHIEVEMENTS, by Francis E. Leupp. Boston: Little, Brown, & Company. See review.

GAS, GASOLINE AND OIL ENGINES, by A. Frederick Collins. New York: D. Appleton & Company. See review.

LAYING DOWN AND TAKING OFF, by Charles Desmond. New York: The Rudder Publishing Company. See review.

THE AMERICAN AIR SERVICE, by Arthur Sweetser, New York and London: D. Appleton & Company. See review.

JOHNSON'S MATERIALS OF CONSTRUCTION, by M. O. Withey and James Aston, edited by F. E. Turneaure. Rewritten, fifth edition. Illustrated. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Review in July issue.

TRAINING FOR THE ELECTRIC RAILWAY BUSINESS, by C. B. Fairchild, Jr., Executive Assistant, Philadelphia Rapid Transit Company. Written under the supervision of T. E. Mitten, Chairman, Executive Committee, Philadelphia Rapid Transit Company. Illustrated with photographs and three charts. Philadelphia and London: J. B. Lippincott Company. Price, cloth, $1.50 net. To be reviewed in July issue.

ZELNICKER'S BULLETIN, Walter A. Zelnicker Supply Co., St. Louis, Mo. No. 258, containing list of rails and accessories in stock.

NELSON'S PERPETUAL LOOSE-LEAF ENCYCLOPAEDIA (specimen pages) John H. Finley, LL.D., Editor-in-Chief. 12 volumes, with 7,000 illustrations, colored plates, colored maps and engravings. We acknowledge special articles for review in July issue.

INDUSTRIAL TRAINING AND FOREIGN TRADE, Bulletin No. 7 of the United States Training Service of the Department of Labor, C. T. Clayton, Director. Washington: Government Printing Office.

COMMERCE AND FINANCE, for May 7, 1919. Edited by Theodore H. Price.

GOVERNMENT PROTECTION OF FOREIGN INVESTMENTS, by Albert Breton, Vice President, Guaranty Trust Co., New York, reprinted from *Scribner's Magazine,* Foreign Trade Department.

LABOR TURNOVER AND INDUSTRIAL TRAINING, Bulletin No. 6 of the United States Training Service of the Department of Labor, C. T. Clayton, Director. Washington: Government Printing Office.

RONALD PRESTIGE, for May, Thomas R. Stewart, Editor. The house journal of the Ronald Press Co., New York.

EXPORT TRADE for April 26, 1919. Vol. 1, No. 5, edited by Laurance T. Clark. New York: Ashwell Davis & Co., Inc.

THE CORN EXCHANGE, Vol. 5, No. 12, the house journal of the Corn Exchange National Bank, Philadelphia.

NOVO-POWER, Vol. 2, No. 2, the house journal of the Novo Engine Co., Lansing, Mich.

TRAINING LABOR FOR PEACE TIME, Bulletin No. 5 of the United States Training Service of the Department of Labor. Washington: Government Printing Office.

VAN NOSTRAND'S RECORD OF SCIENTIFIC LITERATURE, Vol. 36, No. 10. Publisher's Bulletin. New York: D. Van Nostrand Company.

MONTHLY BULLETIN OF BOOKS, May, 1919. Publisher's announcement. New York: The Baker & Taylor Co.

HOG ISLAND NEWS, Vol. 2, No. 19. House journal of the American International Shipbuilding Corporation, B. F. Doran, Editor.

SKETCH OF BRUNO V. NORDBERG

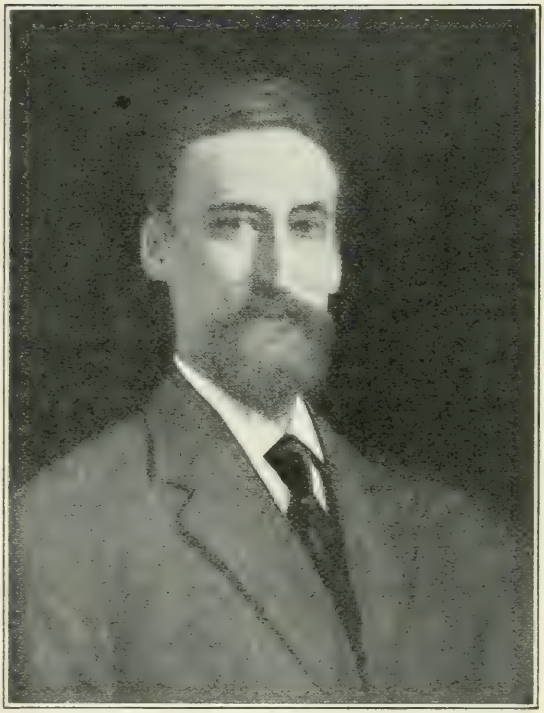
WE HERE present to our readers a portrait of one of the world's great engineers who has done specially notable things in compressed air lines.

Mr. Nordberg was born in Finland, April, 1857, his father operating a shipyard. At the age of 21 he was graduated from the Helsingfors University and shortly afterwards came to this country. His first job was as a draftsman with the E. P. Allis Company, Milwaukee, and within a year he had become the right hand man of Edwin Reynolds, the Corliss engines specialist.

In 1889, Mr. Nordberg established his own concern with a force of six men. In 1892 he built his first steam engine for a Milwaukee brewery and his company became a pioneer American builder of the present type of poppet valve engine.

Subsequently he took up the general manufacture of pumps, Corliss engines, hoists and compressors. In 1899 he designed a pumping engine with a new steam cycle which achieved noteworthy results, increasing the steam engine efficiency beyond the limits before attainable.

He early gained the confidence of the mining men in the copper mines of the Michigan Upper Peninsula, due to his ability to solve successfully problems related to mining machinery and for a number of years his time was largely devoted to designing efficient hoisting, pumping, compressing and stamping machinery for this district, his designs being characterized by the most striking originality.



BRUNO V. NORDBERG

In 1908 the Anaconda Copper Milling Company, Butte, Montana, was confronted with a perplexing problem. They had within a radius of a mile some thirty shifts, each of which was equipped with a separate steam plant for operating its hoist, a very costly arrangement. An abundance of cheap electric current was available, but electric hoists were not satisfactory and Nordberg designed and carried to complete success perhaps the most notable compressed air installation in the world. This was described in COMPRESSED AIR MAGAZINE soon after the event.

Electric driven air compressors were installed, arranged to be started without the use of electricity, thus eliminating the starting parts. These compressors were connected up to a battery of air receivers in which a constant pressure was maintained by means of a static head, furnished by a take located at a sufficient height. Air was piped to the different shafts through a line forming a loop, and air operated hoists—the converted steam hoists—arranged to use the air economically were installed at each shaft. At each hoist a reheater was placed to heat the air before it was used. The entire system was a most radical departure from all familiar practice and was a complete success.

To meet requirements in the Michigan district, Mr. Nordberg designed an extremely large cylindro-conical drum hoist which became a standard design. He is now building a hoist to operate at a maximum depth of 10,000 feet for this district.

During the war Mr. Nordberg was building 1400-hp. vertical triple expansion engines for new ships of the Emergency Fleet Corporation, also special compressors for inflammable gases and machinery for liquifying gases.

Mr. Nordberg has been an active member of the American Society of Mechanical Engineers, contributing valuable papers to its transactions. Outside of engineering circles he is extremely retiring and quiet, but active and alert at his work.

Sailing does lure him away for a two or three weeks' annual cruise about Lake Michigan; he has owned a trim 62-ft. schooner, "Merlin," for 16 years. And sailing, he says, is a splendid sport for the engineer, an avocation affording possibilities seldom accorded it. To Mr. Nordberg it recalls the sport of his youth, sailing about the shores of the Baltic Sea and the Gulf of Bothnia.

Notes of Industry

A Sheffield (England) firm has converted its airplane factory into a plant for the manufacture of small-scale model locomotives and steam engines, which were formerly imported from Germany to the extent of over $4,000,000 annually. Its output will consist of two classes of models, the expensive educational toy and a small engine for workshop use. Each is made exactly to scale and embodies the principles of a full-sized locomotive.

Gas is proving a troublesome problem in Comanche county (Oklahoma) and it looks as though the producers there will have to install casinghead gas plants in self defense, as the state law prevents the waste of gas, and many of the wells won't produce oil till they have blown several hundred million feet of gas off.

In a brief note on tides *Marine Engineering of Canada* draws attention to the infrequently appreciated effect of atmospheric pressure on the magnitude of the tidal wave, saying that if the barometer falls one inch the water rises a foot and a-half. This, of course, is only the case if the barometric disturbance is comparatively local.

It has been officially stated that an 8½ in. cross compound air compressor (air brake pump) will produce approximately three times as much air as will a 9½ in. simple air compressor, and approximately twice as much air as an 11 in. simple air compressor, while the pounds of steam used per 100 cubic feet of air is approximately one-third as much in a cross compound pump as in the simple types.

The headquarters of the Eastern Department Office of the Air Service of the United States, 104 Broad street, New York City, has announced that 15,000 men are wanted for the Air Service at once, and requests enlistments for one to three years, without further obligation to military service. Attention is called to the value of the training to become a pilot or an expert aviation mechanic. Further information may be obtained by applying to the Department Air Service Officer, 104 Broad street, New York City.

A tunnel under the Shimonoseki Strait between the islands of Moji and Kiushu of the Japanese archipelago is one of the newest undertakings up for consideration, although this project has been proposed previously. The tunnel would be 3½ miles long, of which 1 mile would be under the water. The project will cost $8,973,000 to $9,970,000 and require 10 years' time. It has been placed in charge of Doctor Tanabe, who is connected with the engineering college of the Imperial University, Kyoto.

As an indication of the German activities for regaining their trade in the future, it may be mentioned that one large German electrical company has purchased fifteen acres of land just outside of the city of Malmö, in the southern part of Sweden, with the intention of erecting a factory on this site. According to the *Swedish-American Trade Journal,* at least six other German firms have taken similar steps.

A paper read by Mr. T. J. Querette, of the North-East Coast Institution of Engineers, Newcastle-on-Tyne, shows that reinforced concrete vessels of 1000 tons deadweight are 39 per cent. heavier than steel vessels of the same size. With 2000-ton ships the increase is 25.8 per cent.; for 4000 tons 16.5 per cent., and for 6000-ton ships the increase in displacement falls to 11.8 per cent.

It is a remarkable indication of the trend of events that Yarrow and Co., Limited, intend gradually to diminish their output on the Clyde, and increase their output in their works at Vancouver, on the Pacific Coast of North America.

The construction of concrete rolling stock for railroads is under way in Holland. It is stated that only the wheels, axles, buffers and couplings are made of steel, which can only be accepted as an absurd overstatement of the facts. The weight of the cars of the new type is said to be no greater than that of steel cars, the construction is simpler and cheaper and the upkeep light.

A Dutch engineer has evolved a new method of freeing boiler feed water of oil. He subjects the water to the action of 110-volt continuous current, which causes the oil particles to combine into larger masses, after which they are removed by pressure filters.

Where concrete is rammed with a heavy pneumatic rammer, operations may sometimes be considerably facilitated by counter-balancing the rammer and suspending it from an overhead sheave.

The American Institute of Mining and Metallurgical Engineers will hold its convention in Chicago, Sept. 22 to 26. This meeting promises to be one of decided importance to the industry, as subjects of concern in iron and steel will be under discussion. In addition to the technical program excursions are being arranged to the steel mills at Gary, the oil refineries at Whiting, metallurgical plants at East Chicago and North Chicago, and to the La Salle district where the cement, coal and zinc industries are represented.

The Meteorological Section of the Royal Air Force has dispatched an expedition to take "soundings" of the atmosphere over the Atlantic. Every six hours instruments will be sent up by means of kites to determine altitude, humidity, temperature and wind force at heights of 1000 ft., 2000 ft. and 3000 ft. It is expected that the investigations will occupy five weeks.

Piping that is used to carry acetylene or hydrogen should be painted a distinctive color so that it will not be possible to mistake the line for anything else. The infrequent use of piping for such special service renders the precaution more imperative.

Soldiers, sailors and marines recently discharged can avail themselves of an unusual opportunity at the Wentworth Institute, located at Huntington Avenue, Boston, Mass. This Instittue is providing four-months' trade courses in printing, plumbing, machine work, pattern making, carpentry, etc., and not only are the courses free, but housing and board are also provided without cost to the men. The courses are similar to those given last summer to soldiers being trained as mechanicians for the Army.

Owing to the scarcity of timber and steel during the war, the gates for a private dry dock in England were made of reinforced concrete. The dock is 40 feet wide and the gates are 14 feet deep. They are circular in form and despite the 14-foot head of water, are only 3½ inches thick. No waterproofing compound was employed and yet they are said to be perfectly water-tight.

Disposition of the surplus stocks of lead owned by the War Department is being made at current local market prices in the community in which the surplus is held. This surplus is scattered throughout the country, and in no one place is there a large quantity. Reports from the various bureaus show a total amount of 7000 tons of lead to be in possession of the War Department. This surplus of 7000 tons represents but a small percentage of the year's production of lead and is not sufficient in quantity to affect the market in any way.

The United States has only six per cent. of the population of the world and only seven per cent. of the land, and yet we produce:

Of copper	60%	Of the world's supply
" lead	40%	
" zinc	50%	
" aluminum	60%	
" oil	66%	
" corn	75%	
" cotton	60%	
" silver	40%	
" coal	52%	
" gold	20%	
" iron and steel	40%	
" automobiles	85%	
" wheat	25%	

and refine 80 per cent. of the copper and operate 40 per cent. of the world's railroads.

Personal Intelligence

EDITOR'S NOTE—Authentic items of personal intelligence from the industrial fields in which compressed air and pneumatic tools and devices are employed will gladly be received for publication in these columns. Such news paragraphs should be mailed to Editorial Department, Compressed Air Magazine, No. 11, Broadway, New York, by the first day of the month preceding date of publication.

At the annual meeting of the Standard Gas & Electric Company's stockholders, these directors were re-elected: H. M. Byllesby, A. S. Huey, O. E. Osthoff, J. J. O'Brien, George H. Harries, R. J. Graf, D. T. Flynn, W. H. Clarke, S. W. Childs, B. E. Sunny, F. W. Stehr, John H. Roemer, Donald McDonald, Elmer Dover and W. R. Thompson.

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Nicholas J. Cunningham, executive secretary for 16 years of the Springfield (Mo.) Gas & Electric Co. and the Springfield Traction Co., has resigned to devote his energies to developing his large oil acreage in McCulloch county, Texas. Mr. Cunningham has been engaged in the public utilities field since 1903.

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Robert Bryce, of Toronto, has been elected a councilor of the Canadian Mining Institute.

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L. D. Davenport, chief engineer of the Oliver Iron Mining Co. in the Hibbing district, has returned from a pleasure trip in California.

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W. J. Hamilton, consulting engineer of the Cerro de Pasco Copper Co., together with J. M. Boutwell, consulting geologist and C. V. Drew, has sailed from New York for Lima.

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Paul Cowan and Harry Akard of the Bristol (Tenn.) Gas & Electric Co. have entered the service of Messrs. Henry L. Doherty & Co. of New York at Bartlesville, Okla.

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Julian T. Dixon, paymaster of the Republic Iron & Steel Co., died recently at his home in Birmingham, Ala. He had been with the company 19 years.

* * * *

Edward Leonce Dufourcq, long actively engaged as a prominent mining engineer in developing properties in South and Central America, Mexico and the United States, was murdered recently by bandits in Mexico. For the last two years he had been connected with the Teziutlan Copper Co. of New York, as assistant general manager at Teziutlan, State of Pueblo. While testing a new gasoline-driven motor car on the company's railroad line about four miles from the mine in company with Orme Gaisman, a Swiss engineer, he was set upon by the outlaws. Employees found his lifeless body next day. Mr. Dufourcq was born in 1870 and was graduated from Columbia University. For ten years he had been a member of the American Institute of Mining and Metallurgical Engineers. He left a widow and a daughter by a former marriage.

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Col. Duncan N. Hood is in charge of the new Buenos Aires office of the McGraw-Hill Co., Inc., at Calle Corrientes, 685.

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T. J. Hudson has been appointed acting manager of the pneumatic tool sales division of the Chicago Pneumatic Tool Co., succeeding F. H. Waldron, who returned to Minneapolis, Minn., as district sales manager.

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T. E. Doremus has been transferred by E. I. duPont de Nemours & Co. to the E. I. duPont de Nemours Export Company as general eastern manager with headquarters at Shanghai.

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E. H. Myers, Jr., W. A. Channes, W. B. Weston, M. C. Row, and Edgar Berry, all of Tulsa, Okla., have formed the Myers Oil & Gas Corporation with a capitalization of $250,000.

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I. T. Williams has been appointed general manager of the London & Northwestern Railway, of England, succeeding Sir Guy Calthrop, deceased.

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A. A. Woods, formerly superintendent of the New Orleans & Northeastern R. R., has been appointed chief engineer of the Southern R. R. with headquarters at Cincinnati, succeeding Curtis Dougherty, deceased.

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Howland Bancroft and B. L. Thane have formed a partnership as consulting engineers with offices in the Crocker Bldg., San Francisco.

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William Beaudry, director and manager of the Stewart Mining Co. and of the Nabob Consolidated Mining Co., at Kellogg, Idaho, has resigned.

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J. R. Buchanan has been discharged from the Army as Captain of Engineers, and has resumed his position with the Homestead Iron Dyke Mines Co., at Homestead, Oregon.

W. B. Devereux, Jr., Major in the Air Service, has returned from overseas and received his discharge. He will resume his work with the firm of Wilkens & Devereux, in New York.

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Theodore J. Hoover has been appointed Dean of the Mining Department of Stanford University, to take effect on October 1. He will organize the department on the basis of graduate study.

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George W. Blackinton, Major in the A. E. F., formerly office manager at Denver for the Sullivan Machinery Co., has been awarded the D. S. C. for extraordinary heroism at Xammes, France, on September 12, 1918.

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H. E. T. Haultain, professor of mining in the University of Toronto, has been placed in charge of the Vocational Training Branch of the Department of Soldiers' Civil Re-establishment. The entire department is under the direction of W. E. Segsworth, a mining engineer of Toronto.

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Amor F. Keene has accepted the position as consulting engineer and a member of the New York advisory committee of the Gold Fields American Development Co., which is associated with the Consolidated Gold Fields of South Africa.

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Claude Cooper, recently returned from overseas service as Captain in the U. S. Army, has been named as superintendent of the Calumet & Hecla electrolytic plant at Hubbell, Michigan, succeeding J. C. Bryant. Mr. Cooper was formerly asssitant-superintendent of the C. & H. smelting-plant.

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The Chicago Pneumatic Tool Co.'s Boston office has been moved to No. 182, High street, and is under the management of F. S. Eggleston. The company also announces it has opened two new offices in the Southwest, one at Tulsa, Okla., and the other at El Dorado, Kansas.

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J. I. Edwards has been appointed special foreign representative of the Chicago Pneumatic Tool Co. and is leaving for Europe.

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Two new district managers for the Chicago Pneumatic Tool Co. are J. K. Haigh at San Francisco and Nelson B. Gatch at Minneapolis.

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Following his discharge from the United States Army, Edward N. Hay has joined the engineering firm of Robert T. Pollock Company, Boston.

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M. L. Rogers, T. A. Irwin and W. G. Singer of Wilmington, Del., have formed the Hadley Oil Company, with a capitalization of $240,000.

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J. E. Toliver of Colorado Springs, Col., and E. J. Lambert and E. E. Feistel of Tulsa, Okla., have incorporated the Lambert-Toliver Oil & Gas Co. with a capital of $300,000.

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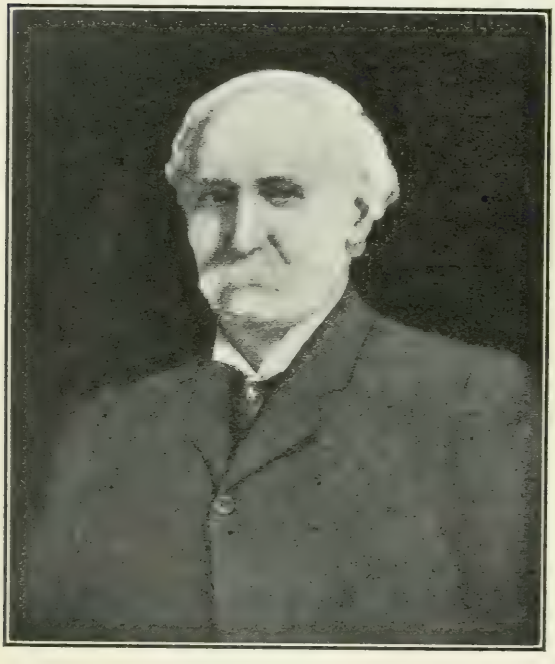
Charles B. Richards, Emeritus Professor of Mechanical Engineering at Yale University, died recently at his home in New Haven in his 86th year, after a long and distinguished career. Born in Brooklyn, where he was educated, he became associated with the late Charles T. Porter, later establishing himself as a designer of machinery. It was through the insistence of Mr. Porter that he finally perfected his celebrated high speed Richards Indicator. He refused to patent it, saying that if he "patented everything he thought of he would soon be in the poorhouse." He finally agreed to sell his right in the invention to Mr. Porter for $100, Porter to patent it and to employ him to obtain the patent. For the achievement of inventing the indicator he was made a Chevalier of the Legion of Honor of France. For many years he was consulting engineer of the Colt's Patent Fire Arms Co., Hartford, and while there designed and built in 1867 two pairs of Porter-Allen engines which are still furnishing power to the older part of that establishment. Leaving a post as superintendent of the Southwark Foundry & Machine Co., Philadelphia, in 1884, he occupied his chair at Yale until 1909, since which time he had been professor emeritus. He was U. S. Commissioner to the Paris Exposition in 1889 and was a fellow of many societies.



CHARLES B. RICHARDS.

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Capt. Geo. Sykes, R. A. F., A. M. I. E. E., for four years a commercial attache of the British War Mission in this country, sailed in May for London to become London manager of the engineering and railroad departments of Messrs. Dutilh-Smith McMillan Co. For several years before the war Capt. Sykes was engaged in electrical engineering lines and with power and traction interests. His London address will be Central Building, Totehill street, Westminster, where he will be pleased to see American friends.

Latest U. S. Patents

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MARCH 4.

1,295,889. PRESSURE-GAGE FOR TIRES. Benjamin G. Gilbough, Los Angeles, Cal.

1,295,947. COMPRESSOR. Fred W. Wolfe, Chicago, Ill.

1,295,981. COMBINED CENTRIFUGAL AND AIR-LIFT PUMP. Carl Hallauer, Los Angeles, Cal.

1,295,991. AIR-PUMP FOR AUTOMOBILES. George W. Kellogg, Rochester, N. Y.

1,296,012. REFRIGERATION APPARATUS. Edwin R. Sage, Jersey City, N. J.

1,296,079. VACUUM LIFTING APPARATUS. Halbert K. Hitchcock, Pittsburgh, Pa., and William J. Golightly, Kokomo, Ind.

1,296,107. CALKING AND GLAZING DEVICE. Orley R. Oakley, Decatur, Ill.

1,296,121. SUCTION-CLEANER. William W. Rosenfield, New York, N. Y.

1,296,190. APPARATUS FOR THE CONCENTRATION OF ORES. James M. Hyde, Palo Alto, Cal.

1,296,312. TUNNEL-SHIELD. John F. O'Rourke, New York, N. Y.

1,296,315. AIR-WASHING APPARATUS. William D. Philips, Brooklyn, N. Y.

1,296,359. PNEUMATIC MAT. Daniel Webster Brown, Youngstown, Ohio.

1,296,363. FUEL-FEEDING DEVICE FOR INTERNAL-COMBUSTION ENGINES. Charles S. Burton, Oak Park, Ill.

1,296,443. AIR-COOLING SYSTEM FOR INTER-

NAL-COMBUSTION MOTORS. Horace W. Turner, Wilmington, Del.

1,296,524. VACUUM FUEL-FEED DEVICE. Webb Jay, Chicago, Ill.

1,296,526. VACUUM-OPERATING LOCK. George C. Jensen, Oakland, Cal.

MARCH 11.

1,296,657. PRESSURE-REGULATOR. Theodore A. Hammond, Passaic, N. J.

1,296,735. INTERNAL-COMBUSTION-ENGINE VACUUM ACTUATING MEANS. Samuel F. Arbuckle, Indianapolis, Ind.

1,296,828. HYDROTURBINE VACUUM-PUMP. Edward F. McCarthy, Chicago, Ill.

1,296,869. BLOW-TORCH. Leon U. Snow, Lincoln, Neb.

1,296,926. APPARATUS FOR PRODUCING COMMINUTED MATERIAL. John W. Cox, Erie, Pa.

3. In an apparatus for producing comminuted material, the combination of devices for conveying the material and directing the same to fall by gravity in an open stream across an air passage; means for creating a current of air through the passage and falling material, comprising a fan; pipes connecting the fan with the inlet and outlet of said passage; and a separator arranged in the pipe circuit.

1,296,968. METHOD OF SUPPLYING AIR TO INTERIORS. Albert R. Klein, New York, N. Y.

1,297,005. AUTOMATIC CONTROL FOR VACUUM-PUMPS OR THE LIKE. Frank R. Perry, Chicago, Ill.

1,297,130. SYSTEM OF SHIP PROPULSION. William L. R. Emmet, Schenectady, N. Y.

1,297,165. AIR-BRAKE FOR AUTOMOBILES. George C. Higbee, Tekoa, Wash.

1,297,191. VENTILATING APPARATUS FOR MINES. Daniel F. Lepley, Connellsville, Pa.

1,297,223. SAND-BLAST APPARATUS. William P. Mott, Chicago, Ill.

MARCH 18.

1,297,374. GAS-BURNING APPLIANCE. Elmer T. Lutz, Kansas City, Mo.

1,297,422. ELECTROPNEUMATIC BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,297,437. STRAIGHT-AIR ONE-MAN EQUIPMENT. Joseph M. Bosenbury, Peoria, Ill.

1,297,508-20. FLUID-PRESSURE BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,297,535. PNEUMATIC TRIGGER-PULL FOR FIREARMS. Alexander Boynton, U. S. National Army.

1. A firearm containing firing mechanism with a manual trigger, and having pneumatically actuated means operatively connected with the firing mechanism and not with the trigger, to normally actuate said firing mechanism independently of the trigger, leaving said trigger unobstructed for the free application of the finger for manual operation of the firearm at times when a pneumatic impulse cannot be conveniently applied to said firing mechanism by said means.

1,297,679. PNEUMATIC TOOL. Charles H. Haeseler, Philadelphia, Pa.

1,297,687. PNEUMATIC SWITCH. William E. Haskell, Brattleboro, Vt.

1,297,692. ROTARY COMPRESSOR. Irving C. Jennings, South Norwalk, Conn

1,297,693. ROTARY FLUID-PRESSURE DEVICE. Otto W. Johnson, San Francisco, Cal.

1,297,706. GLASS-BLOWING MACHINE. James W. Lynch, East St. Louis, Ill.

1,297,716. PROCESS OF OZONING SUBSTANCES. Alfred J. Moisant, New York, N. Y.

1,297,803. ELASTIC-FLUID TURBINE. Harvey N. Davis, Cambridge, Mass.

1,297,855. VACUUM-DISTRIBUTER FOR INTERNAL-COMBUSTION ENGINES. Samuel D. Irwin, Floydada, Tex.

1,297,864. ELASTIC-FLUID TURBINE. William L. King, Cincinnati, Ohio.

1,297,878. ELASTIC-FLUID TURBINE. William J. A. London, Springfield, Mass.

1,297,884. AIR-BRAKE SYSTEM. George Macloskie, Erie, Pa.

1,297,924. AIR-DUMPING BALLAST-CAR. Thomas N. Solomon and Harry D. Solomon, Detroit, Mich.

1,297,958. GAS AND AIR MIXING DEVICE. Edward C. Wulfeck, Cincinnati, Ohio.

1,297,981. AUTOMATIC GLASS GATHERING AND BLOWING MACHINE. Arthur Wilzin, St. Ouen, France.

MARCH 25.

1,297,999. PNEUMATIC BRAKE AND CLUTCH CONTROLLER FOR AUTOMOBILES. Corwin W. Bryant, Minneapolis, Minn.

1,298,111. VACUUM-PUMP. Charles Neville Sowden, Central Caracas, Cuba.

1,298,113. PLAYER-PIANO PNEUMATIC. Charles H. Spencer, Baltimore, Md.

1,298,195. FLUID-LINE-PRESSURE-REGULATING VALVE. Edward J. Fries and Thomas F. Dickey, Toledo, Ohio.

1,298,291. GOVERNOR FOR AIR-MOTORS. Melville Clark, Chicago, Ill.

1,298,491. PNEUMATIC ACTION FOR PIANO-PLAYERS. Archibald Eaton Goldspink, Kentish Town, London, England.

1,298,557. AIR STARTING MEANS FOR INTERNAL-COMBUSTION ENGINES. Otto F. Persson, Erie, Pa.

APRIL 1.

1,298,655. SYSTEM OF AIR DISTRIBUTION. Emil A. Briner, East Orange, N. J.

1,298,664. VACUUM-PUMP. Lewis W. Chubb, Edgewood Park, Pa.

1,298,742. SUBAQUEOUS TUNNELING. Frank D. Leffingwell, Montclair, N. J.

1,298,880. SUBAQUEOUS TORCH AND METHOD OF IGNITING. Friedrich Wilhelm Brusch and Walter Franz Josef Beyer, Dortmund, Germany.

1,298,903. VACUUM SYSTEM. Carl R. Daellenbach, Ellwood City, Pa.

1,299,059. DEVICE FOR THE AERATION AND EMULSIFYING OF PULP FOR FLOTATION. Charles Taylor, Nogales, Ariz.

1,299,151. COMBINED WINDMILL AND AIR-COMPRESSING MECHANISM. John D. Ebert, Kinsley, Kans.

1,299,211. GAS-COMPRESSOR. Charles R. Neeson, New Rochelle, N. Y.

1,299,268-70. LOCOMOTIVE-BRAKE EQUIPMENT. Walter V. Turner, Wilkinsburg, Pa.

1,299,290. AIR-BRUSH. Johannes Berg, Chicago, Ill.

Six Months' Advance Notice

An important announcement will appear in the July issue of Compressed Air Magazine regarding an increase in the subscription price of the magazine and an increase in advertising rates, both effective as of January 1, 1920.

The type dress of the magazine will be altered also on that date and its size will be increased to the standard 9x12 inches.

Subscribers and advertisers will please carefully note the July announcement.

Compressed Air Magazine Co.

COMPRESSED AIR MAGAZINE

Vol. XXIV JULY, 1919 No. VII

Education in Compressed Air Practice

By FRANCIS JUDSON TIETSORT

F. J. TIETSORT.

ANNOUNCEMENT was made in last month's issue of this magazine of an effort by the editors to ascertain the sentiment of educators, manufacturers, engineers and others, on the subject of additional educational facilities in the field of compressed air. In addition to the published announcement, letters were sent out to the heads of schools of technology, university engineering departments, mining schools, and to individual engineers and other recognized authorities. In this circular communication the editors announced their desire to obtain the views of those addressed as to whether it was advisable to have established a chair, or special course of teaching, in one or more of the schools of technology or universities of the United States. Attention was called to the fact that applications of compressed air in the greatest industries of the United States, as well as throughout other industrial nations, had now become so manifold that special knowledge on the subject was becoming indispensable.

We expressed it as our belief that the topic was one that was holding the attention and deep interest of engineers, of all users of compressed air equipment, manufacturers of compressed air and pneumatic apparatus, salesmen, contractors and of students themselves. We inquired for opinions as to: (1) a special addition to the curricula of the technical schools; (2) what the proposed course should consist of; (3) whether there should be a chair of compressed air engineering, special instructors, or what; (4) what institutions such a course should be given in.

Our inquiries originated as the result of expressions from engineers connected with large industrial houses to the effect that there was sometimes a real difficulty in obtaining the services of young engineers that were well-grounded in the details of compressed air practice.

At the outset we should make plain that there has been no thought expressed that general engineering knowledge should be subordinated to a secondary position; the intelligent application of compressed air principles in everyday practice involves, of course, too many demands upon the great general field of mechanical engineering. The uppermost idea has been to obtain views, from various angles, of men well versed in the subject, for the benefit of our readers, in order that they might form their own conclusions.

As the result of these inquiries it may be possible for someone to suggest an intelligent programme for making compressed air education more available for students who may desire to enter either the field of compressed air machinery manufacture, or other fields wherein compressed air and pneumatic devices are largely utilized. The benefits accruing both to the man who enjoys this specialized knowledge, and to his employer, are so obvious that they are not a subject for debate.

We are quite aware that many of our technology schools and universities are already giving a very considerable amount of attention to compressed air. We are rather astonished, however, at the great number of replies and the variety of replies that our symposium has called forth. We note a pronounced disposition on the part of educators, one with which we feel in accord, not to allow any one specialty to interfere with the absorption by the student of general engineering knowledge. There seems to be in some cases a disposition to make a special course on the subject an *elective* postgraduate course, and possibly that is a solution for certain schools. Under such conditions there seems no objection to it as a special curriculum, though the thought of a "chair of compressed air" has fewer proponents. Such a chair, granted a sufficient endowment, might prove a success and warranted, in such an organization as that of the Massachusetts Institute of Technology, but, in most cases, college faculties and trustees are not likely to favor a "chair," and for obvious reasons.

We shall be happy, if, in our soundings of opinion, we shall have created a sufficient sentiment to instigate action looking to the educational betterment sought. There are many wealthy men connected with the compressed air machinery industry, as well as in those lines of manufacture in which this elemental plays an indispensable part. A large percentage of these gentlemen are engineer alumni of famous schools. It is not impossible that some benefactor or group of benefactors may properly estimate the importance of the need and take the step required to meet it from the manufacturer's viewpoint. Additional endowments in the cases of some schools, may prove unnecessary. Still, whoever heard of a school that did not need more funds!

Judging from the response to the announcement made by COMPRESSED AIR MAGAZINE, which was so large that we find it impractical to publish all of the replies in this issue, the original conception of the importance of the subject was not far from accurate. We take pleasure herewith in presenting some of the replies received; others will be made public in the August issue.

Views of Leading Authorities

By RICHARD C. MACLAURIN

President, Massachusetts Institute of Technology

The questions raised in your letter of May 19th are of special interest to this Institute which realizes the growing importance of the use of compressed air in various industries of the country. Familiarity with the subject is deemed of such importance that it now occupies a considerable portion of the course in Mechanical Engineering here. *This course attracts a larger number of students than any of our engineering courses* and these students are picked men who come from practically every State in the Union.

The students in our course in Mechanical Engineering are made familiar with the fundamental principles of the thermodynamics of gases and of the different methods of compressing air. This course deals with such matters as the effect of clearance in compressors, displacement efficiency, the efficiency of compression, the temperature at the end of compression, the saving made by two-stage compression and the proper pressure to be carried at the end of the first stage in order equally to divide the work between the two stages, similar calculations for a three-stage machine, method of lubrication of the compression cylinders, use of oil, soft soap, etc., the transmission of compressed air in pipes, the flow of compressed air through orifices and thin plates and the method of testing a compressor for its displacement efficiency, etc., the measurement of air under low pressures, the effect of humidity of the air, the use of compressed air in Pohlé air lifts and in pneumatic tools.

In all cases the matter is dealt with partly by lectures but largely by experimentation in well-equipped laboratories.

What is mainly needed now is the provision of *further facilities for research. The endowment of a chair of compressed air engineering would be particularly useful* if the occupant of the chair were given opportunities *to carry on and direct research* and were charged with the duty of caring for the interests of the relatively small number who would really profit by greater specialization during their student days than is indicated in the outline of the course that I have referred to above.

It would, I believe, be a mistake to encourage specialization at the expense of a broad training in the things that are fundamental in the great profession of Mechanical Engineering.

By ELMO G. HARRIS

Professor of Civil Engineering, School of Mines and Metallurgy, University of Missouri, Rolla, Mo.

In the discussion about putting a course in compressed air in one of the universities, I offer the following:

For the last ten years the Missouri School of Mines, has given a course in compressed air, consisting of one semester (4½ months)—two lecture periods per week and one afternoon for special problems and laboratory work. Up to two years ago it was required in the mining course. It is now elective. Alumni writing back express appreciation of the course—so much so that we feel that the time has been well used.

It is the writer's opinion that a course in compressed air should be offered (as an elective perhaps) to students in mining and in mechanical engineering. The subject would logically follow thermo-dynamics. It should be confined (except in laboratory work) to the fundamentals—chiefly mathematical. Few engineers will master the elusive mathematical laws governing the control of air (compressed or not) unless under the tutelage of professors.

The writer is less sure about the advisability of giving much time to study of special machines. They are too transitory. Such work might be confined to vocational training.

By E. J. McCAUSTLAND
Dean and Director, School of Engineering, University of Missouri, Columbia, Mo.

In answer to yours of May 19 in the matter of the establishment of a chair or course of teaching for compressed air in the schools of technology in the United States:

There can be no question that the applications of compressed air are becoming so varied and important that special knowledge must be acquired by men who hope to succeed in that branch of engineering.

The problem you propound is one not easily answered in an offhand manner. In the first place, I believe most educators will agree that a long period of training in the fundamentals of science should precede the study of special applications in any specific field. It would appear therefore, that an adequate treatment of the subject of compressed air should take its place as a special addition to be made in some curriculum of a technical school, most suitably, perhaps, as part of the mechanical engineering curriculum. Mathematics, including the calculus, physics with special work in the subject of heat and a strong course in theoretical thermodynamics would prepare the student for the applications of compressed air in the industries.

I cannot at this moment pretend to suggest the scope of the proposed course, but answering your question as the wisdom of establishing a chair of compressed air engineering or special instructors, I should say that this would be wise *only in case the school was likely to furnish enough students in the particular field to occupy the time of an expert and was sufficiently well equipped in its laboratory facilities to enable such expert to carry on work that might be with justice classed as research work.* To conduct a course that merely describes installations and equipment would, I believe, be less effective than to direct the student into some industrial activity making use of compressed air machinery. On the other hand, to place the student in a well equipped laboratory and encourage him to carry on investigations, original with himself at least, is an excellent means of fitting such a man to take his place in the industries as a valuable employee.

It follows from the above that only such institutions as are well equipped with funds should attempt to offer such a special course.

By MORTIMER E. COOLEY
Dean Colleges of Engineering and Architecture, University of Michigan, Ann Arbor.

The subject of compressed air has, in my opinion been too much neglected in our engineering college curricula. It has been crowded out by subjects considered more important. Just at the time compressed air was forging to the front, electricity came into practical use. With new subjects constantly arising, engineering curricula gradually became crowded, and now four years is not enough time for fundamentals alone.

The literature on compressed air, thirty to forty years ago, was becoming voluminous. A great deal had been done on transmission at low pressures. But curiously enough, nothing has been done on transmission at high pressures.

We, at one time, specialized here to some extent in compressed air; that is, we offered courses in the subject and also in mechanical refrigeration. That was twenty-five or thirty years ago. I taught the subjects myself.

When our new engineering building was planned in 1902, we provided for experimental work in air under high pressures, 2000 lbs. per square inch, and above. A mile of extra heavy pipe was to be installed at the ceiling of our naval tank in order to determine losses in transmission at high pressure. Later, we purchased a compressed air plant built for one of the dynamite cruisers of the Navy, and later used by the Union Traction Company of Chicago to propel street cars. The compressors were rebuilt and installed about 1908.

It is to be regretted that the tests contemplated have never been made. Overcrowded curricula, large numbers of students and overworked faculty are the chief reasons.

I should hardly think it desirable, at the outset, to establish a Chair of Compressed Air Engineering. It might be offered as one of the branches of thermodynamics, or as a course entitled Compressed Air.

If a Chair of Compressed Air Engineering is to be established, it might be well to confine it to one or two institutions and make as much of it as possible. Engineers desiring to specialize in compressed air could go to that particular institution.

The institution selected should be from among those leading in engineering, and it should have the cordial support of all the others in helping to develop the course.

It would be well to have those particularly interested come together to work out the character of the course, its scope and the method of teaching it.

By P. F. WALKER
Dean, School of Engineering, The University of Kansas, Lawrence, Kas.

In reply to your letter of May 19th regarding the teaching of compressed air in universities:

1. Shall a special addition be made to the curriculum of the technical school? Only in a brief way to supplement existing training courses.

2. Of what shall the proposed course consist? A few lectures and applicatory problems in regular designing.

3. Shall there be a chair of compressed air engineering; no; special instructor may be necessary in large schools.

4. In what institution shall such a special course be given? So far as indicated above, in any school.

In the above it is not meant that the topic is not one of vital importance. Educational tendencies, however, are in the direction of renewed emphasis on general fundamental sciences. It seems to us more appropriate for manufacturers of compressed air machinery to open special schools, as so many other groups of manufacturers have done.

By H. V. CARPENTER
Dean, Mechanical Arts and Engineering, State College of Washington, Pullman, Wash.

Answering your inquiry of May 19th regarding the desirability of establishing a chair or course of teaching covering the subject of compressed air, I wish to make the following suggestions:

You could to good advantage take steps to encourage the listing of more elective courses, especially courses including laboratory practice in the curricula of Mechanical Engineering schools. You could arrange for a committee of those best qualified to investigate the possibility of establishing in perhaps two or three prominent engineering schools of a group of courses, which would permit students to specialize in more difficult problems arising in the application of compressed air.

It seems to me very likely a well equipped research laboratory studying the possibilities for any applications of compressed air might meet with success in quite a number of good directions.

From CHARLES H. SNOW
Dean, School of Applied Science (Engineering), New York University, University Heights, New York

In reply to your invitation of May 19th I enclose herewith a report made by Dr. Daniel W. Hering who had to do with, what I believe to be, one of the first attempts to organize a course on compressed air.

It may interest you to know that one of those who took this course was Mr. W. W. Wotherspoon, N. Y. U. '98, who has since had much to do with the salvaging of ships by compressed air.

Please feel free to arrange this material as may seem best to you. I am sorry for the pressure that makes it necessary for me to send it in as it came to me.

New York University, May 26th, 1919.

Dr. Charles H. Snow,
Dean of the School of Applied Science.

Dear Dr. Snow:—While I do not feel at liberty to answer directly the letter you received from the Managing Editor of the Compressed Air Magazine, I am writing you some of my views concerning the propriety of including compressed air specifically in engineering instruction, of which you are at liberty to make such use as you may see fit. Certainly the magazine is making a good move. Through Messrs. Saunders, Richards, and many other active, capable engineers who have worked with it and for it, it has done great service to engineering practice. In connection with the subject of this letter, as long ago as October, 1908, it spoke of New York University as being exceptional among educational institutions in offering a course in compressed air and its applications.

How far it is desirable or expedient to go in dealing with a special subject is for each institution to decide for itself. There would be abundant material, and a field broad enough and sufficiently diversified for an elaborate treatment of the subject of compressed air, but it does not seem to me that it would be any more appropriate to make a special type of engineering of it, than of, say, railway surveying, which has been extensively developed, or of explosives, or of the manufacture and use of dyes, or of paints. But to such an extent has compressed air come into the service of the engineer, and so great a part does it play in determining both the economical performance of a piece of work and the quality of the work when finished, that no civil or mechanical engineer today is well qualified for practice who has not had some training in this subject. I think no considerable piece of engineering work is put through nowadays, in which compressed air is not an important factor.

Inasmuch, however, as it rests upon fundamental principles, mathematics, physics, and applied mechanics, which are the same as those of other branches of engineering, namely, mechanical engineering, bridge engineering, and engineering construction generally, I would not make this a separate type of engineering, but would provide a course in this subject which should take it up technically only after the student has had good training in his chemistry, mathematics, and physics; say, not before the third year of his engineering course.

Then some portions of this work, like thermodynamics, and the use of the indicator would coincide with what he was studying in connection with other branches of engineering. I may say, however, that I found that the students in steam engineering were so imbued with the conditions attending the expansion and cooling of steam, that they were confused rather than helped by it when it came to considering the compression and accompanying heating of air.

My own experience in presenting the subject at New York University extended over nearly twenty years, and while it never reached the rank to which I thought the subject was entitled, it enabled me to get pretty definite ideas of what would be suitable for it in a good engineering school. It began with us in a very moderate way, with senior engineers,—simply a brief course of lectures, six or eight, supplementing others on the production, measurement, and transmission of power. Year by year the work in compressed air was expanded and systematized, until it comprised about twenty-five lectures, besides occasional laboratory experiments or demonstrations.

The course consisted of first a generally descriptive and historical account of *applications,* fully illustrated, showing the great variety of ways in which the engineer utilizes compressed air; then, a more intense, careful, detailed discussion of the theoretical principles, with quizzes, and numerical practical problems relating to temperatures, power, economy, mechanical efficiency, etc., and some indicator tests, and inspection of compressed air features in engineering work then in progress. Good examples were the Jerome Park reservoir, and the cleaning of the 155th street viaduct by the sand blast.

In a more complete handling of the subject, probably refrigeration would find a place, and other important topics to which I could only allude, and perhaps regular lessons from a text book would be of advantage. I must say, however, that I know of no one text book that would satisfy me. My work was entirely with seniors, and I think it properly belongs to the student's senior or junior year.

Even with the limitations under which I gave the lectures, I believe they were worth while. With the great expansion of compressed air practice since I first took up the study, I do not see how it can be omitted from the engineer's training. It should have a fully recognized status in the curriculum, and a foundation that would support such a course of instruction, not omitting practical work in a suitably equipped laboratory, would add much, in my opinion, to the completeness and value of the work of the institution giving it.

Somebody must have thought my work desirable, for, as perhaps you know, my entire illustrated manuscript of the course was appropriated, and has disappeared. I have felt its loss very keenly.

Sincerely yours,

D. W. HERING.

By C. R. RICHARDS
College of Engineering, University of Illinois, Urbana-Champaign, Ill.

In reply to your letter of May 19 in regard to the importance of increased attention to the subject of compressed air in the engineering curriculums of our technical schools, I beg to submit the following:

1. In my opinion it would be unwise, if not undesirable, to establish a special curriculum in compressed air engineering. I do not think enough students would be interested in such a highly specialized course to justify the colleges of the country in undertaking it.

2. Practically every curriculum in mechanical engineering now gives considerable attention to problems

the principles of mechanism and in machine design as well as in the use of a great variety of air appliances in our Shop Laboratories.

3. I should not consider it essential that there be a chair of compressed air engineering, or that instructors be appointed to handle this subject to the exclusion of others. We have a number of men in our Department of Mechanical Engineering who are well informed concerning the theory and practice in this work.

I have always been tremendously interested in the subject of compressed air. I have already prepared one bulletin of our Engineering Experiment Station, entitled "Entropy—Temperature and Transmission Diagrams for Air," and we have two manuscripts devoted to certain phases of compressed air utilization, which we hope to publish in due time.

By F. PAUL ANDERSON
Dean, College of Engineering, University of Kentucky, Lexington, Ky.

I believe it would be a very desirable move to have a special course in compressed air engineering in one or two of the universities in the United States. This course could be an under-graduate course leading to the degree Bachelor of Science in Compressed Air Engineering.

I am opposed to having too many special courses in the undergraduate engineering course. I believe in a basic fixed course for engineering, with no electives. If a special course in compressed air engineering existed in some one or two universities, the course could be so arranged as to allow men to go from various engineering schools and take a post graduate course. The degree should then be Mechanical Engineer. I appreciate fully that the average course in mechanical engineering does not have enough time to give to engineering problems pertaining to compressed air practice.

By WILLIAM PRELLWITZ
Chief Engineer, Ingersoll-Rand Co., Phillipsburg, N. J.

Referring to your letter of the 19th, asking about the establishment of a chair or course of teaching for compressed air in one or more of the universities or schools of technology in the United States, note that the writer has no opinion to offer in reference to this.

Personally we do not think a special course in compressed air engineering is required as much as a good course in thermodynamics, and in that course give a little more detailed attention to its application to air compressors and this will answer all as regards theoretical learning that is required.

As regards its practical application, the course could include the proper installation of air compressors, including their pipe lines, air receivers and the advantages in aftercooler to take out the moisture, and the course could further include all the application of compressed air.

By F. W. ATKINSON
President, Polytechnic Institute, Brooklyn, N. Y.

There are very few institutions where a special professorship or even instructorship in compressed air would be advisable. The fundamentals of compressed air operations are covered in the course in thermodynamics; some practical experience is given in the Mechanical Labarotory work; and this, I believe, is sufficient for the education of under-graduate mechanical engineers.

Further training in the subject would fall under the head of specialized training, which is not advisable.

The subject of compressed air might very well be made a major for a graduate degree, and for those schools doing a great deal in graduate work, that might be desirable.

By F. A. JIMERSON
Chief Engineer, Ingersoll-Rand Co., Factory, Athens, Pa.

Replying to your inquiry of May 19th I believe that a short practical course in compressed air engineering would undoubtedly be of value to a great majority of mechanical and mining engineering students. To the best of my knowledge no special courses are offered along these lines, although a certain amount of theory relative to compression and expansion of air is usually taught in the thermodynamic courses.

The average technical graduate leaves school with no practical knowledge of the application of compressed air to the industries. In fact, he more than likely to believe that compressed air is a thing of the past dying a hard death because of the development of electrical machinery and appliances.

A study of the shipbuilding industry, of the railroads, of machine shops and of foundries will convince the most skeptical that compressed air is secondary only to steam and electricity as applied to the above and many other industries.

Nearly every engineering student elects or is required to take a course in hydraulic engineering, very likely he elects a course in water turbine design and follows with laboratory work. Nine times out of ten he has no opportunity to apply this knowledge in later life. Examples of other courses offering much less of practical value to the average man than a knowledge of pneumatic machinery might be mentioned, but I merely desire to bring out the necessity of introducing into the curricula of technical schools practical, not theoretical, courses in compressed air engineering and the application of compressed air to the industries.

By JOHN R. ALLEN
Dean, College of Engineering and Architecture, University of Minnesota, Minneapolis, Minn.

I have your favor of May 19th in regard to having a chair in compressed air. I was connected with the University of Michigan for about twenty years and for a number of years gave a special course in compressed air and compressed air machinery. Personally I do not believe in establishing a course in compressed air engineering.

I do not believe that there is any such thing. A man to properly do his work in compressed air lines should be a thoroughly trained mechanical engineer, particularly should his course embrace thermodynamics. In addition to that he might have one or two special courses in compressed air and compressed air machinery.

I think this is as far as any college would be warranetd in going in a specialization of this kind.

By ROBERT PEELE
Professor of Mining Engineering, School of Mines, Columbia University, New York Ctiy

Responding to your letter of May 19, I would suggest the following considerations regarding the proposal to establish a course of teaching in compressed air engineering.

1. The principles of air compression, and the transmission of power by compressed air, are now given thoroughly in several technical schools, as a part of the newly-develpoed subject of "Engineering Thermodynamics."

2. The salient details of the design and operation of compressors and their accessories, from the stand-

point of the user, are included in well-conducted courses in Mechanical Engineering.

3. The courses of study in technical schools covering the elements, principles and practice of Mechanical Engineering as a whole, are already seriously overcrowded.

It should be remembered that these studies must be preceded by a long period of training in Mechanical Drafting, Mathematics (up to and including Calculus), Physics, Mechanics, Properties and Resistance of Materials, Graphic Statics, and other fundamental subjects.

Furthermore, in a well planned curriculum, the laboratory work accompanying these courses occupies the afternoons of about two years, added to which is summer vacation work in Shop Practice and Machine Design.

4. The field of present day Mechanical Engineering is so wide that to attempt to make a specialty of any one branch would prevent a thorough drill in the fundamental subjects.

5. I think it would be undesirable to establish a special course in compressed air engineering. The details of the subject, including design of the machinery, uses of compressed air, etc., would best be left to a period of training in the shops of makers of compressors and rock drills; this training to follow the courses of study given in technical schools.

By MERTON L. EMERSON
Vice President, American Pneumatic Service Company, Boston, Mass.

Referring to your letter of May 19, I am giving my personal views on the subject of the establishment of a chair, or course of teaching, for compressed air in one or more of the universities or schools of technology in the United States.

The only training in "Compressed Air" given in most scientific institutions is the basic course in thermodynamics which is later followed by courses in steam engineering.

I can see no field for a class of compressed air engineers as, for example, similar to the existing class of electrical engineers; but I believe that in all general engineering courses the same relative attention should be given to compressed air engineering as is given to steam engineering.

Too much attention cannot be given, first of all, to the present courses in thermodynamics. I would suggest that half the time that might be applied to a course in compressed air engineering be given to a further study of thermodynamics. Then, with this absolute grounding in theory, the balance of the available time could be well divided between lectures and laboratory work.

The lectures, say ten in number, should, I believe, cover the general application of compressed air in the industrial field and could well be given by experts in the different lines of such application. The laboratory work should in general follow the practices governing any steam engineering laboratory work.

Any large technical school could well have a professor of compressed air engineering, just as well as they have a professor in steam engineering. Students in the general courses of mechanical, electrical and civil engineering should be allowed to *specialize in such a course as an option,* just as they are now given other options in their respective courses.

The policy should be, however, to educate young engineers on the basic principles of theory and practice and to let them become specialists at a later time if they are so qualified.

By ALBERT M. GREENE, JR.
Professor, Department of Mechanical Engineering, Russell Sage Foundation, Rensselaer Polytechnic Institute, Troy, N. Y.

We have your letter of May 19th and in reply to this we would state that in our course in Heat Engineering given to Mechanical Engineers and Electric Engineers, we take up the problems in compressed air. This work considers the methods of compression, power required to compress air under different conditions, losses in air transmission and application of compressed air to air motors. In our Mechanical Engineering Course our men test and examine a two-stage air compressor. We believe that the amount of work we give to compressed air is sufficient for the general mechanical engineering training.

Although the use of compressed air is extensive and the applications numerous, we do not believe that it is wise to make any further addition to the curricula of the technical schools. There is entirely too much specialization in our schools, and what we need is to have thorough ground work done, and the men taught to think. If they have the fundamentals well assimilated and know how to think it takes but a short while to learn the peculiarities of any special branch of engineering.

For this reason we believe that a chair of compressed air engineering with special instructors is entirely out of place. Many of the leading engineers in the works where compressed air machinery is built and developed have had a general mechanical engineering course, and I am sure these men would agree with me that a strong general course in engineering is much to be preferred to a special course in compressed air engineering.

By A. G. CHRISTIE
Associate Professor, Dept. of Engineering, Johns Hopkins University, Baltimore, Md.

We recognize the growing importance of compressed air in the arts and industries, and feel that something should be included in our technical courses covering this subject. We have recently had a long discussion on the subject contents of our courses and have come to the conclusion that we can give a better all-around engineering training by sticking quite closely to the main fundamentals of engineering, and leaving the special studies for graduate work. We have therefore included among our advanced graduate courses such special studies as refrigeration, gas engines, steam turbines, advanced production engineering, compressed air, and so on.

Referring to the specific questions which you have asked, I would say therefore that we do not believe that an addition of another course in compressed air is possible in our under-graduate curriculum, although it has a legitimate place in our advanced studies. The course which I have in mind for this advanced work will consist of a thorough study of the thermodynamic relations of air, or air compressing machinery; a study of its functions in the laboratory, and the applications of compressed air.

It seems to me that a great deal of help could be given to the colleges by manufacturers of compressed air equipment if arrangements were made to furnish laboratory apparatus and demonstrating equipment of their products to the various colleges.

I have in mind one of the large laboratories in Germany, which was furnished with a very elaborate equipment of air compressors and compressed air machinery , and where tests and research work were done on the power required to drive various compressed air tools.

on air compression and transmission. This is true at the University of Illinois, and I feel confident that it is true in other institutions. Our students secure a good understanding of the principles involved in compression and expansion of compressed air, and we give considerable emphasis to the transmission of gases and vapors through pipelines. We do not give very much attention to machines designed to use compressed air, but this does not seem to be essential, since our students receive a thorough training in

You ask whether a chair of compressed air engineering should be founded, and at what institution. If a specialized course is considered, I should think that it could only be founded at one of the largest of our universities where considerable graduate work is possible, such as Massachusetts Institute of Technology or Cornell, or possibly one of the Western schools, such as Wisconsin, Michigan or Illinois.

By GEORGE M. RICHARDS
Yarnall-Waring Co., Philadelphia

We beg to advise that we are in full accord with you in the establishment of a Chair or University Course in Compressed Air Engineering.

In view of the present wide and constantly broadening field for compressed air such a course should embody all the uses it is now put to as well as its future possibilities.

As we have come in contact with more graduates of Cornell University and the Massachusetts Institute of Technology who are in some way specializing in this particular branch of engineering, we naturally would give the preference to either one of these institutions.

By ALBERT W. SMITH
Dean, Sibley College, Cornell University, Ithaca, N. Y.

For many years we have realized the importance of the subjects of compressed air for students of engineering, and in connection with our courses in Heat Power Engineering we have been giving some special attention to this subject. We shall continue to develop the teaching as the importance increases.

It does not seem to the writer necessary to establish a special chair of compressed air in engineering as it is distinctly a part of another subject. All men who graduate from Sibley College have received a fundamental training in connection with this subject, and I believe this is a foundation upon which to build further knowledge should their experience in practical life demand it.

By EDWARD ELLERY
Dean of the Faculty, Union College, Schnectady, N. Y.

In reply to your letter regarding a course in compressed air engineering in our educational institutions I would state that it seems to me the purpose of such a course would be realized either by including the subject in some part of a mechanical engineering course already offered or by a series of lectures on the subject by some expert in a given period of the scholastic year. I do not believe that the subject should be added to the curriculum as a distince course.

We find the views thus far expressed of ready interest and are hopeful that they will stimulate a further discussion of the subject throughout the entire field of compressed air. We shall be pleased to receive further expressions from our readers.

The majority of responses indicate that if there is to be the foundation of a chair of compressed air it logically might be in connection with the Massachusetts Institute of Technology or some leading university having a large number of engineering students. Some of the replies received would indicate that their writers were under the misapprehension that the thought involved in the discussion was that *every* institution with a college of engineering should have a special course in compressed air. This idea is in error, as reference to the symposium questionnaire will show.

AIRPLANE DIRECTION FINDER

The problems involved in the safe and successful navigating of the air are far more complicated and difficult than is generally appreciated. One of the most important of these problems was presented in a recent lecture by Maj.-Gen. G. O. Squier before the American Institute of Engineers.

One of the principal problems of airplane navigation, said Gen. Squier, has been the evolution of a suitable compass, particularly for night landing work. Magnetic and gyroscopic compasses have limitations at present which make impossible reliable air navigation by dead reckoning.

The use of directional effects of loops or coils for receiving radio signals has resulted in the development of a radio compass for airplanes which gives positive information to the aërial navigator and enables him either to locate his position by triangulation with respect to two beacon land stations or to fly at any given angle with respect to a certain beacon station.

The apparatus consists of two principal parts—the antenna coils and the turning and amplifying apparatus. The antenna coils are mounted in the fuselage of the Handley-Page airplane, with suitable means for rotating in azimuth. The amplifier is extremely sensitive, consisting of a detector and six-stage amplifier. A novel feature of the amplifier is the use of iron-core transformers for frequencies of 100,000 cycles.

The direction of the beacon land radio station is determined by maximum strength of signals, in a highly ingenious manner developed originally by the British. The precision of the directional effect is remarkable. In fact, the radio direction finder may well be called a radio eye, by which the aërial navigator sees one or more radio lighthouses which are sending identifying signals to guide him on his way. These lighthouses, furthermore, have certain advantages over the normal lighthouse in that their ranges may be much greater and they are not invisible in the daytime nor obscured by fog and mist.

Building Steam Shovels With the Aid of Air

By WALTER P. BURN

IN THE YEAR 1884, a small plant in the town of Marion, Ohio, started to build steam shovels. At that time the steam shovel was a new device and there was little or no competition. Today, despite the great number of other firms manufacturing the same products, the Marion Steam Shovel Company dominates the town of Marion, and is the very life and center of it.

W. P. BURN.

The plant occupies seventy-five acres of ground, and is complete within itself. That means that it has its own open hearth steel and manganese steel furnaces and foundries, its own boiler, structural and fabricating plants, its own iron, brass, bronze and aluminum foundries, its own chain shop, lumber yards and saw mills—in fact, every department necessary to convert raw materials into the finished product.

Building steam shovels at Marion is an art. The matter of boiler capacities, engine horsepower, proportions of crane and dipper handle, ratios of gearing and the like, were long ago reduced to a science. So, for the last few years the problems of refinement of the product have received most careful attention; every effort has been made to produce a steel, for example that will be the ideal material for the dipper, a different steel for the gears, a perfect bronze for bearings.

The effort to improve materials is perhaps best illustrated by the steam shovel chain made at Marion. The chain is made entirely by hand, and each weld is made in two heats to insure proper annealing and prevent setting up of unnecessary strain in any link. The most interesting feature of Marion chain, however, is the stock from which it is made. To produce the material, square bars of pig iron and of soft steel with wrought iron scrap are piled up in the manner shown in Fig. 1—the black squares representing iron, the lighter steel. The piles are then bound together and rolled, producing a round stock which has a cross-section like that of Fig. 2. It is claimed that this stock has all the advantages to be derived from the toughness and resistance to shock of the steel, and the resistance to wear of the pig iron. The double "working" of the material doubtless enhances its toughness also.

In addition to improving materials, the Marion Steam Shovel Company has made every effort to increase the efficiency of its foundries and shops. To this end, compressed air has been extensively employed, and once more demonstrated its value as an aid to efficient production. Almost every step in the making of the steam shovel involves the use of air tools.

The first step in the construction of a steam shovel is the building of the frame. This requires careful design, as it bears all the shocks of operation. In the Marion Shovel, the frame is constructed of four large I-beam sills connected by deep separators of heavy cast iron. The solidity of the frame is so important that the separators are machined to fit the beam contours exactly before the parts are riveted together. Four tie-rods to each set of separators give additional strength to the frame.

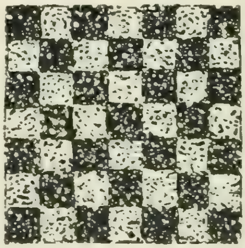


FIG. 1.

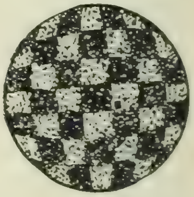
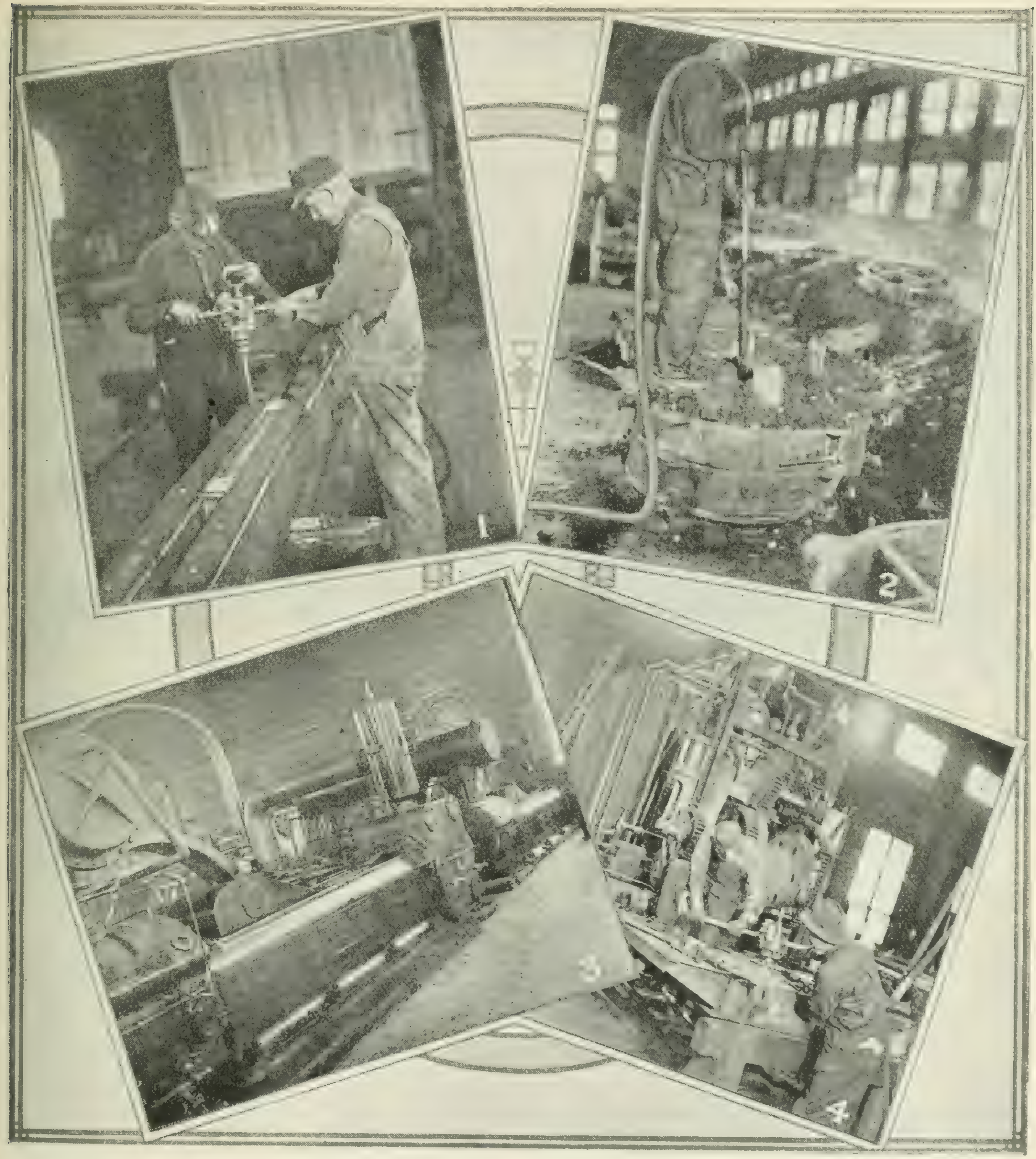


FIG. 2.

The car frame is placed upon heavy cast wheels, tractors with spur gearing or railroad trucks, and upon it is mounted the rotating frame. The latter consists of a one-piece steel casting to which is solidly anchored an extension framework of beams and channels firmly riveted together.

The boilers used are mainly of the locomotive water-tube type, although a fire tube boiler is used on some of the smaller shovels. The boilers are built in the Marion Shops almost exclusively with air tools, the latter being employed for reaming, riveting, rolling and beading the flues, tapping for staybolts, and caulking seams, rivet and staybolt heads. In the assembly of the shovel, the boiler is mounted upon the swinging extension framework.

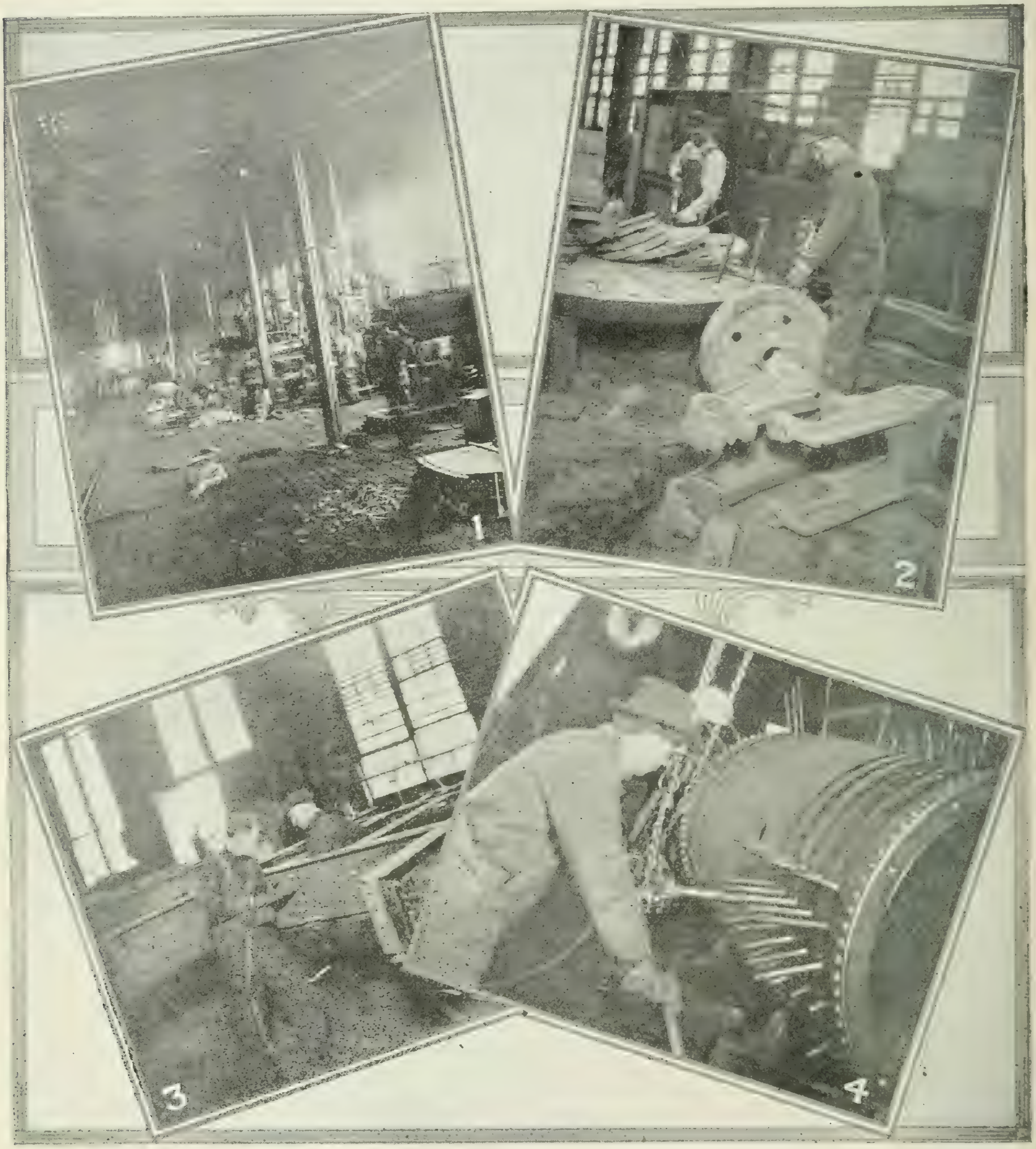
Operating machinery comprises a swinging en-



1.—DRILLING OAK PORTION OF DIPPER HANDLE WITH PNEUMATIC WOOD-BORING MACHINE.
2.—PNEUMATIC SAND RAMMER AT WORK IN MARION FOUNDRY.
3.—COMPRESSOR INSTALLATION OF MARION STEAM SHOVEL PLANT, CAPACITY ABOUT 3,000 CU. FT. OF FREE AIR PER MINUTE AT 80 TO 100 LBS. PRESSURE.
4.—DRILLING FLOOR FOR ANCHOR BOLTS WHEN ASSEMBLING.

gine, used for propelling the shovel and swinging the revolving frame as well as operating the boom; a hoisting engine for manipulation of the dipper; and crowding engines for adjusting the shipper shaft.

The hoisting and swinging engines and hoisting machinery are secured to the main rotating frame casting. Their functions are easily understood, as the swinging engine serves to swing the revolving frame so that the boom extends in any desir-



1.—PORTION OF MACHINE SHOP SHOWING STRAIGHT LIFT AIR HOISTS EMPLOYED.
2.—TRIMMING CASTINGS WITH A PNEUMATIC CHIPPING HAMMER.
3.—RIVETING EXTENSION FRAME OF A STEAM SHOVEL.
4.—TAPPING BOILER FOR FLEXIBLE STAYBOLTS WITH A PNEUMATIC DRILL.

ed direction, and the hoisting machinery raises the dipper up and down by means of cables passing over the upper end of the boom and secured to the dipper itself.

The crowding engine is a small engine mounted on the boom at the fulcrum point of the dipper handle, and serves to shorten or lengthen the leverage of the dipper by changing its point of balance. It operates through a gear driving a rack, called the shipper shaft, attached to the boom.

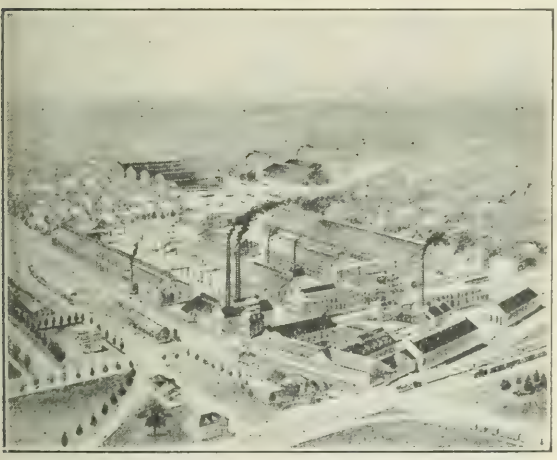
The hoisting engines are double, equipped with link reverse, and connected to the drums by friction bands. The bands are operated by a steam ram in order to relieve the operator of all strain.

All machinery except the main engine, hoisting engines and crowding engine is mounted on the extension of the swinging frame.

The boom is built of seasoned oak, heavily reinforced with steel plates on top and bottom extending over its entire length and firmly trussed together. At the base is attached a heavy open-hearth steel casting to give strength and stability.

The dipper handle is also of the combination oak and steel type and reinforced with steel bars, top and bottom. The racking is made of a special manganese steel and is firmly secured by through-bolts to each number, besides being riveted to the bottom bars. In the making of both the dipper handle and boom, pneumatic tools are extensively used for riveting, chipping and wood boring.

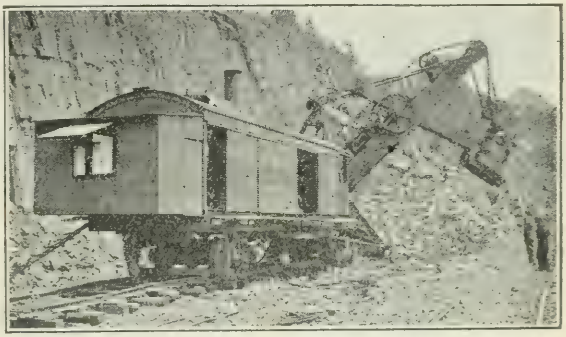
The dipper itself is made of open-hearth steel with the exception of the jaws, which are of a special manganese steel. The need of a hard, tough material for the jaws is obvious when it is considered that they are often required to cut through hard shale or similar material.



"AIRPLANE VIEW" OF THE PLANT OF THE MARION STEAM SHOVEL CO. AT MARION, OHIO.

The use of air tools in the making of a steam shovel is even more extensive than has been indicated. In the foundry, pneumatic sand rammers are employed to save time and produce sharper castings, free from "pin-holes." The castings are trimmed by means of air hammers, and many minor operations of assembly, grinding, drilling, reaming and hoisting are performed by pneumatic tools. The company has wisely adopted the policy of standardizing on a single make, and is using the "Little David" line.

The compressor equipment consists of two Ingersoll-Rand "Imperial" type XC3 machines, with compound steam ends and two-stage compression. They have a combined capacity of about 3,200 cubic feet of free air per minute, at 100 pounds pressure.

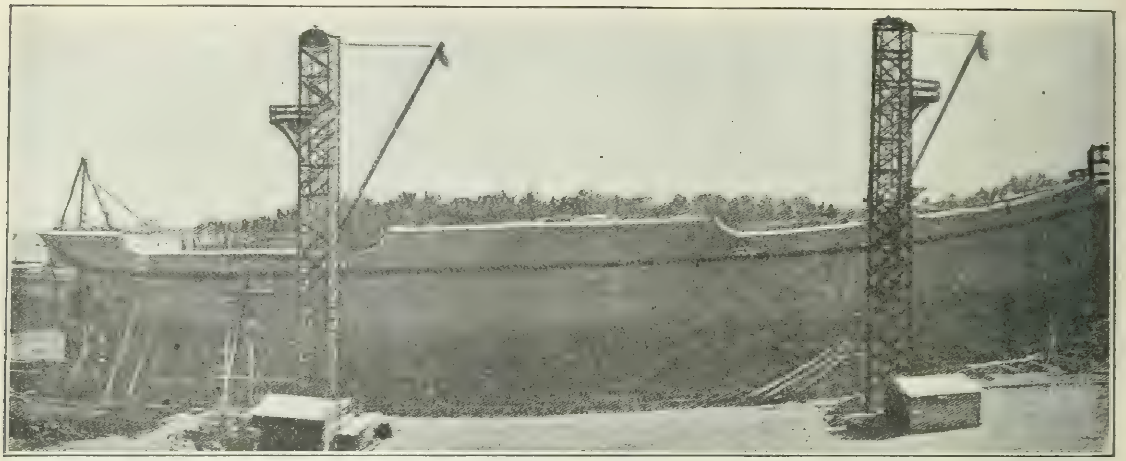


RAILROAD TYPE SHOVEL AT WORK.

Some of the care put into the making of Marion Shovels might at first thought seem unnecessary; the company maintains a large laboratory of tests and inspections to insure the perfection of every piece of raw material and completed part that goes into one of its steam shovels. But when we consider that the contractor often places great reliance on the ability of his shovel to stay at work, and save him time penalties; and that great numbers of shovels are located in the Phillipines, South America and other far-off places, where it would be extremely difficult to make repairs, we see the importance of making the steam shovel as perfect as possible. It is gratifying to note how extensively air tools are employed in the manufacture of this high-grade product.

An American Petroleum Institute has been formed with its headquarters in Washington. Its function will be to promote mutual coöperation between representatives of the industry and the departmental or legislative organizations of the Government.

The output of Japanese coal mines during the last seven years was, in tons, as follows: In 1912, 15,709,663; 1913; 17,050,267; 1914, 17,289,861; 1915, 15,488,828; 1916, 17,476,803; 1917, 19,887,147, and 1918, 20,835,254.



THE *POLIAS*, SECOND LARGEST CONCRETE SHIP IN THE WORLD, BUILT BY VIBRATING THE CONCRETE FORMS WITH A PNEUMATIC HAMMER TO PERMIT OF A DRYER AND STRONGER MIXTURE OF CONCRETE.

The Concrete Ship "Polias" Launched

Pneumatic Hammers used to Settle Concrete Mixture by Vibrating the Forms

THE SECOND largest concrete ship in the world, the S. S. *Polias*, was launched on May 22 at the Fougner Yard, North Beach, Long Island, New York, by the Fougner Concrete Ship Building Company for the Concrete Ship Section of the United States Shipping Board. Through the courtesy of the Portland Cement Association of No. 347 Madison avenue, New York, we are glad to present to our readers a narrative of the building of the *Polias*. For the accompanying illustrations we are indebted to *Concrete Craft*, issued by the Concrete Ship Publishing Corporation, New York.

The vessel was constructed under the supervision of Mr. H. A. Hyman, General Superintendent of the Fougner yard, and of Mr. Walter R. Harper, engineer, Resident Representative of the concrete section of the Shipping Board. Mr. Joseph di Statio was the designing engineer. This craft has a length over all of 281 feet, 9 inches, a beam of 46 feet and a moulded depth of 26 feet, 6 inches. The *Polias* is second in size in the world as a concrete ship only to the *Faith*, launched a year earlier in San Francisco. In addition to these two there are now only three other concrete ships in existence: the *Atlantus*, launched last December, now undergoing trial; the *Palo Alto*, lately launched by the Shipping Board, and the *Armistice*, plying between Rotterdam and English ports.

The construction of the *Polias* was started in August, 1918, the first steps being to lay off on the mould loft floor at full size the water lines at intervals of 3 feet, and the fore and aft body plans with lines every 4 feet, or sections through the ship at each frame, which are 4 feet on centres. Moulds or templates were made from the body plans at each frame, from which the outside forms for the concrete were made to follow the true lines of the ship. Moulds for the inside forms are also made from the body plans.

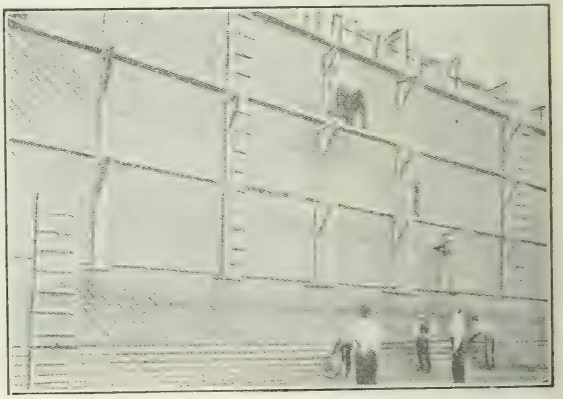


FIG. 1—NAILING STEEL REINFORCING BARS.

The reinforcing steel in the concrete shell is bent to conform to the lines of the ship from these templates. The outside forms of ⅞-inch dressed lumber make a complete wooden shell, having the shape of the ship, while the inside forms 5 inches away make a second wooden shell, or, in other words, we have two wooden shells. Between these two shells is placed the reinforcing steel which is installed before the inside forms are placed.

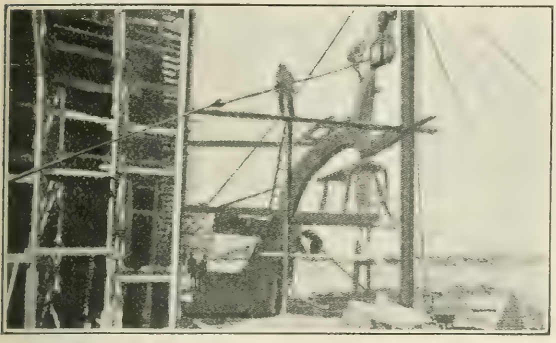


FIG. 2—PUTTING THE STERN FRAME INTO PLACE.

Into this space, between the two forms containing the reinforced steel, is poured the concrete, which hardens and takes the lines of the ship. The concrete could not be tamped on account of the intricate mass of steel, which consisted of four diagonal layers of steel ½ inch and ⅝ inch in size, 4 inches on centres.

To make the concrete dense and to settle it around the steel, small pneumatic hammers were used to vibrate the forms. The application of the hammer, a "Little David" made by the Ingersoll-Rand Company, is shown in an accompanying photograph, Fig. 4.

This was a new method of tamping concrete and was found to give excellent results. Vibrating the forms in this manner permitted the use of a rather dry mixture, and therefore the obtaining of a greater strength than could have been obtained with a wet or sloppy mixture, which it would have been necessary to use in order that the concrete could thoroughly imbed all the steel.

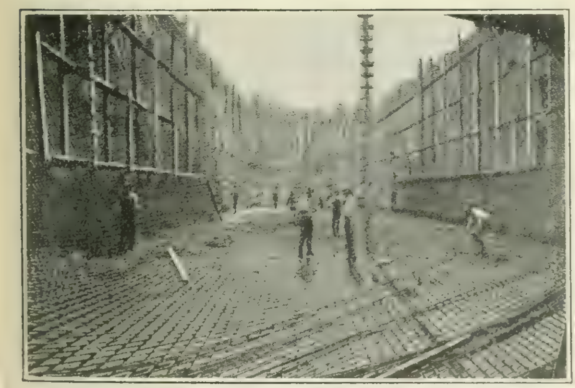


FIG. 3—AT THE AGE OF ONE MONTH, BILGE AND SHELL STEEL WELL UNDER WAY.

The mixture for the concrete used is one part cement, two-thirds part sand, one and one-third part gravel, making a one-half mortar. Compression tests average 5,000 pounds per square inch, some tests running as high as 5,500 pounds per square inch. About 1,450 cubic yards of concrete and 525 tons of steel were used in the construction of the ship.

This was pioneer work, there being no previous work of this kind to refer to when the question of methods to be used came up. Consequently the engineers in charge were called upon to exercise a great deal of ingenuity and many new methods were tried out on various parts of the work.

The contractors were also handicapped in not having mechanics who had had previous experience in concrete ship building, as no concrete ships had been built in this vicinity, and only three in any part of the country. It was not possible to obtain mechanics who had had previous experience on like concrete work. However, some of the men had worked on concrete barges, which is quite a hard type of construction. With perseverance on the part of the engineers in charge, very good results were obtained.

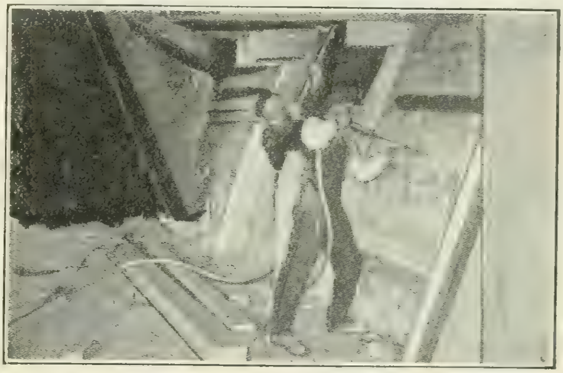


FIG. 4—VIBRATING THE FORMS WITH PNEUMATIC HAMMERS.

The concrete in the bottom and outside shell of the ship is 5 inches in thickness. The main deck has a thickness of 4½ inches, while the forecastle, poop and bridge decks are only 3 inches in thickness.

The ship is designed for carrying general cargo and merchandise, and its cargo holds are large and free from obstructions. The forward hold is considerably larger than the aft. There are four water tight bulkheads, one in forward part which forms the forward peak tank, one at each end of the engine room and boiler room, separating them from the fore and aft cargo holds, and one water tight bulkhead located aft, forming the aft peak tank. The fore and aft peak tanks are for water ballast, also a sea water ballast tank amidship under the engine room.

The machinery for propelling the *Polias* is located at midships. Two coal burning boilers of the water tube type, each containing 2,500 square feet of heating surface, will furnish steam for all machinery. The main engine is a 1,400-horsepower triple expansion vertical marine, exhausting into condenser, which is common marine practice.

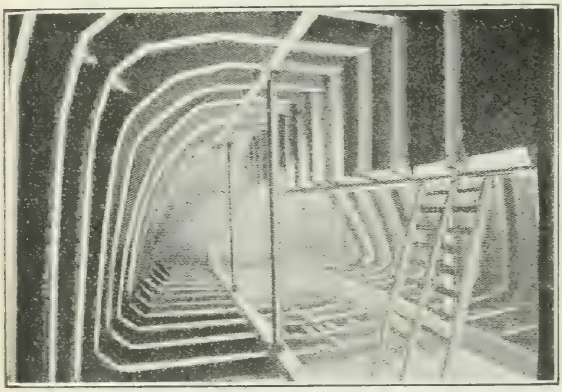


FIG. 5—INTERIOR OF THE HULL SHOWING RIBS AND SHAFT.

Reserve boiler feed water tanks constructed of concrete are located under engine and boiler room floor, thereby omitting the usual steel tanks, which are often located in aft cargo hold. This arrangement adds about 2,500 cubic feet of cargo space to aft cargo hold.

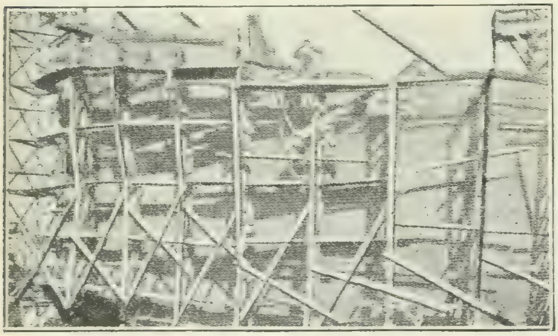


FIG. 6—FINISHING THE EXTERIOR WITH THE CEMENT GUN.

Electric current is supplied by a 15 K.W. generator, driven by a vertical engine. Refrigeration is supplied by a 1-ton ice machnie, which is located in the engine room starboardside.

The refrigerator room is located on the bridge deck just off the galley. All pump auxiliaries will be so connected that in case of a breakdown of any one pump, its functions will be performed by another pump and enable the crew to make repairs if possible. Cargo will be handled by eight cargo winches, one for each boom. The windlass is of the Hyde make, two cylinders, 7 inches by 7 inches.

The steering engine is also of the Hyde make, and is of design known as a quadrant type. The control from wheel house is by means of an electric telemotor. A hand steer is also provided on the poop deck to be used in case of emergency. Hot and cold water and shower baths are supplied for the quarters of officers and crew. The vessel is fitted throughout with modern sanitary plumbing.

The *Polias* is to be outfitted and will have her machinery installed at Providence, R. I. She will have her trial trip some time in the early part of the autumn.

The Bureau of Standards announces a continuation of a service available in its gage laboratories in Washington, New York and Cleveland, Ohio. In general two kinds of services are rendered. The first is advice and research by its technical staff, where the results are of general utility to American manufacturers; for such work no charge is made. Second, the routine testing of gages for manufacturers for which a charge is made according to the following schedule of fees: Plain plug gages, plain ring gages, snap gages, flat or round end standards or checks —50 cents each; measurement of any one element, such as lead, angle or diameter, of threaded plug gages—50 cents each; measurement of lead or angle of threaded ring gages—50 cents; complete measurements of thread gages—$1 each; photographs of form of thread of threaded plug or threaded ring gages—25 cents each; profile gages or fixtures (depending upon the complexity)—$1 up. All gages, instruments or tools submitted for test should be accompanied with drawings or specifications to which they are to conform; also complete information to the route of shipments of gages, nature of the test desired and disposal of the gages after test.

With a view of obtaining the enlistment of 15,000 men for the air service, literature is being circulated from 104 Broad street, New York City, by the Department of Air Service. Those desiring to become aviators, dirigible balloon pilots, chauffeurs, mechanics, or work at some one of the thirty other trades required in the air service, are invited to forward their names to the address mentioned.

A COMPRESSOR LUBRICATION SUGGESTION

By C. T. BAKER

The article by Mr. H. V. Conrad, page 9072, *et seq,* March issue of COMPRESSED AIR MAGAZINE, concerning the lubrication of air compressors, is excellent, and should be given serious consideration by the owners and operators of such machinery.

If I may add a suggestion in this connection, I would strongly advocate the use of a suitable oil separator to be placed on the discharge line between the air cylinder and air receiver, and so arranged as to permit the blowing out of the entrapped oil at regular intervals, say once each day.

An oil separator such as is used on the gas-discharge lines of ammonia compressors would meet the requirements.

By following this plan most of the oil passing from the air-compressor cylinders will be entrapped and prevented from getting over to the air receiver, and this oil when drawn off can usually be used to advantage somewhere about the plant if properly filtered.

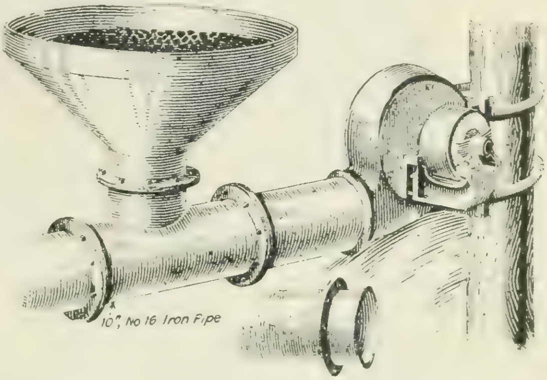
Another thing in this connection: It would help matters to place on the drain of the air receiver a suitable trap to automatically drain it of moisture and oil. This trap would, of course, be similar to the ordinary steam trap, except that its valves should be designed for the character of the work they are to perform. It should be by-passed, permitting hand draining of the receiver in case trap repairs are to be made.

In discussing the paper on lubrication, read before the Physical Society by Principal S. Skinner, C. T. Thomsen said that it had been found that among mineral oils the best lubricants were those with a large proportion of unsaturated hydrocarbons. It is thought that the more of these that are present the more intimately the oil will adhere to a metallic surface. Now, some of the animal and vegetable oils are very largely composed of unsaturated constituents, so that this property of adherence to metallic surfaces may readily be greater in these cases. He thought compressibility was of negligible importance.—*The Engineer.*

STORING COAL WITH A FAN

The illustration shows a method of handling coal for storage successfully employed by Mr. H. H. Finch and described by him in a recent issue of *Power.* For several years the coal for the use of the plant had been stored on a lot about 200 ft. square and a number of men were generally employed in wheeling it back.

This was slow and expensive, and to eliminate useless work, writes Mr. Finch, "I had some 10 in. pipe made from No. 16 iron joined together end to end, each end being flanged and fitted with a collar for the purpose of securing the lengths together so that they would not work loose. The tee to which the hopper is secured is made of cast iron. An old blower did the business and it handled the coal faster than four men could find the hopper."



HOW BLOWER KEEPS FOUR MEN BUSY FEEDING THE HOPPER.

In order to keep the coal on the lot a back-stop was put up, but this did not stop the dust, so a hole was made about two feet from the discharge end of the pipe and a hose nozzle so inserted as to spray water against the air blast, which broke up the water into a fine mist and mixed it with the coal.

The pipe was about 70 ft. long in 10-ft. lengths. The blower is driven by a 25-hp. motor, and the coal is stacked from ten to twelve feet deep. It can be stored at a very low cost with this machine.

A new world's record in shaft sinking was obtained in December, 1918, at the Crown Mines, Johannesburg, South Africa. The shaft at which the record was made is circular, having a diameter of 20 ft. inside the walling, and during December was sunk 279 ft., or from a depth of 655 to 934 ft., the average speed being nine feet in 24 hours. The cost of sinking, exclusive of walling, was between £13 and £14 per ft. during the month.

The previous world's record was also held at the Crown Mines, where 252 ft. was made in a 31-day month at the No. 14 circular shaft of the mines; this was also a 20-ft. shaft. R. C. Warriner, 120 Broadway, New York, was consulting engineer at the Crown Mines up to the end of 1918.

Determination of Amount of Air Leakage

For a System of Pipes and Receivers the Volume of Which Cannot Easily be Measured

By P. H. TROUT, JR.

(Associate of American Institute of Electrical Engineers, Roanoke, Va.)

(Copyright, 1919, by Compressed Air Magazine Co.)

THE METHOD followed in this undertaking is as follows:

At the luncheon hour, one compressor is run long enough (until 12:2:0) to insure that no air is being utilized at the beginning of the test. It is then cut off and the air allowed to leak from the system, thus gradually reducing the pressure. At 12:20:0 one compressor of known capacity is started so that the pressure will be brought back to its full value (100 lbs. per sq. in. gauge) before the men again begin work at 12:30:0.

Readings are taken of the pressure gauge and times and plotted in two curves. The amount of the leakage is calculated from these curves.

As a check on the calculations and the method, the volume of the system was figured from the curves and compared with the best approximation of the actual volume as obtained by measuring the receivers and estimating the pipes.

It is assumed that the condition of the system as to leakage remains unchanged during the test. Also that the compressor is delivering its full rated capacity (1562 cu. ft. free air per min.) just before the regulator or unloader operates (12:26:0, Point E of the curve). These assumptions can usually be checked and verified in each case.

CALCULATIONS

Let t equal *times*

p' equal pressures while the system is leaking only

p'' equal pressures while the system is being filled, the leaks remaining the same.

At the point A we have $\frac{dp'}{dt}$ equals 8.75

At the point E we have $\frac{dp''}{dt}$ equals 10.62

Total.................... 19.37 which is the rate at which the pressure would have risen had there been no leakage. If, at the point E, the compressor is furnishing 1526 cu. ft. of free air per min. to the system, then the *leakage* amounts to $\frac{8.75}{19.37}$ times 1562, equals 705.6 cu. ft. of free air per min., leaving 856.4 cu. ft. of free air per min. to go towards filling the system.

On the tangent FE this would raise the pressure from 0 to 101 lbs. guage in nine minutes and thirty-six seconds (12:26:0: less 12:16:24:) in which time 9.6 times 856.4 equal 8239.4 cu. ft. of free air would have been delivered to the system, over and above the leakage. This is equivalent to a volume of 1066 cu. ft. which is the *volume* as calculated from the curves.

$$\frac{101 \text{ plus } 15}{15} \text{ equals } 7.73 \quad \frac{856.4 \text{ times } 9.6}{7.73} \text{ equals } 1066.$$

RESULTS

Date.	Leakage in cu. ft. of free air per min.	Volume as calculated from curves.
5-2-19	1013	1098
5-5	997	1231
5-6	777	1267
	Repair work stopped	
5-7	960	1074
5-8	1095	1099
	Heavy repairs	
5-15	706	1066

Average 1139

Which is to be compared with

Volume of receivers, measured.......... 705

Volumes of 5″ 6″ and 7″ mains, estimated. 285

Volumes of 2″ 1″ ¾″ and ½ inch pipes and hose guess 100

1090

REMARKS

The method does not interfere with the regular operation of the system, nor does the plant have to run overtime.

It does not require special instruments.

It gives results based on actual operative conditions.

Any intelligent station engineer or repair foreman can compare two curves and see that the gauge falls lower on one day than another, while on the other hand, the plant superintendent can form a very fair idea of the cost of the leakage and of how much he can afford to spend on pipe line maintenance.

Repairs were made from May 1st until May 12th and then on account of other work were dis-

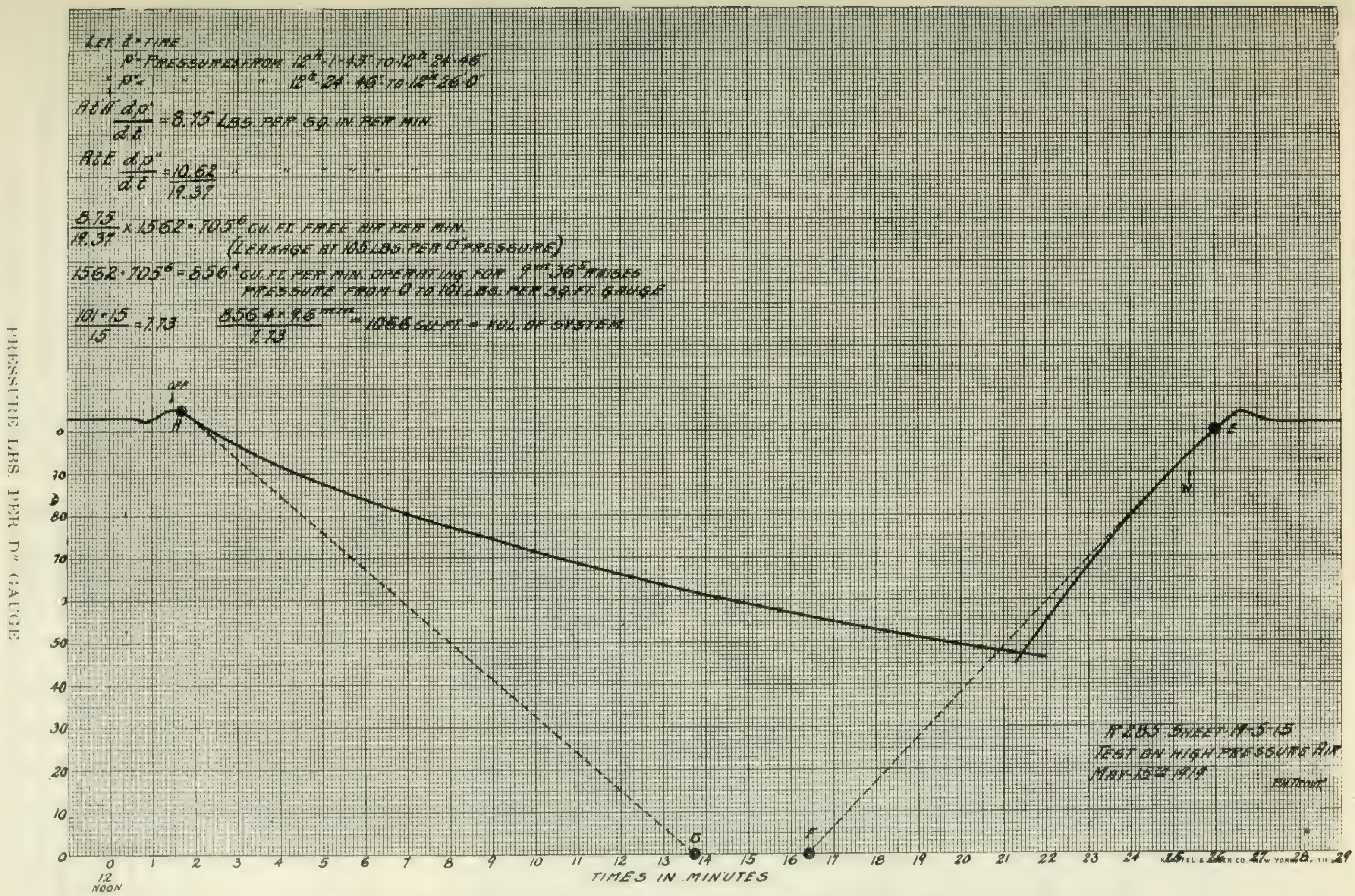


Chart showing test by Mr. Trout on high pressure air, May 15, 1919.

THIS CHART WILL BE SELF-EXPLANATORY TO ENGINEERS IN CONNECTION WITH MR. TROUT'S ACCOMPANYING ARTICLE ON DETERMINATION OF AMOUNT OF AIR LEAKAGE.

continued until May 12th. Special effort was made on May 14th and 15th to reduce leakage to a minimum. Repair parts and special fittings and valves have been ordered and further tests will be made after their installation.

Knowing the cost of compressing one cu. ft. of free air per min. and the number of hours that the plant runs, the cost of the leakage can easily be figured. Allowance should be made for the air which is in the system when it is shut down.

Simultaneous values from the leakage curve can be substituted in the general equation of a conic section

$(m-x)^2$ plus $(n-y)^2$ equals e^2 (y sin a plus x cos a-d$)^2$

and the values of m,n,e,a and d determined.

The curve would probably be found to be a hyperbola with its axis at 45 degrees to the present co-ordinates, and the law governing the flow of air from the average orifice found in actual practice would be known and would probably be found to follow the law of the flow of air through a long thin pipe, rather than the law of flow through a standard orifice in a thin plate.

DUST EXPLOSIONS AND FIRES IN THRESHING MACHINES

Numerous explosions and fires in threshing machines have been reported in the last few years in the large grain growing sections; probably many more than would commonly be supposed. Since 1914 more than 700 have occurred in the Pacific Northwest alone, about 300 taking place in 1914 and almost as many in 1915. To determine the causes of these fires and explosions, and to develop methods of prevention, the U. S. Department of Agriculture has conducted an extensive investigation, during the course of which the following facts have been brought out:

Of the total number of machines thus affected in 1915 over 27 per cent. represented a complete loss, and 34 per cent. partial damage, the rest being but slightly affected.

More than 80 per cent. of the explosions and fires may be classified as wheat smut dust explosions, and approximately 76 per cent. originate near the cylinder in the front part of the machine. Over 75 per cent. of these occurrences were due to the ignition of the smut dust by the discharge of static electricity generated by the operation of the machine.

During the last three seasons three principal methods of prevention, developed and tested by the Department of Agriculture, have been generally adopted, and are now being made a permanent part of the machine equipment.

1. Installation of an effective fire extinguisher especially designed for threshing machines. In the event of a fire, this not only saves the machine, but also prevents the spreading of flames to the nearby grain and straw.
2. The installation of an exhaust fan to collect and remove smut and dust from the separator, thus preventing the formation of an explosive mixture of dusts.
3. Installation of an effective grounding system for the removal of static electricity from the machine.

The field men of the Department have found that machines properly equipped in this way have not experienced explosions and fires, while those not so equipped have suffered extensive damage, with destruction also to the surrounding grain.

HOW HOT AIR SPREADS FIRES

*BY IRA H. WOOLSON**

Although the hallway floors of a building may be of tile or marble and the stairways built entirely of marble, stone or metal, with no combustible material about them, they are nevertheless a serious fire hazard, because they act as flues to carry the hot products of combustion from a fire in one part of a building to another where combustible material is present. The danger of this method of fire transmission is little appreciated by those who have not studied it.

When air is heated to 1000° F. or over—which is a temperature quickly reached in most fires—it will ignite instantly everything combustible with which it comes in contact. The actual flames of a fire may extend only a few feet from the point of origin, but the hot smoke and invisible heat waves may easily travel through an incombustible stairway or hallway for 50 or 100 ft. and then ignite the whole surface of a wooden door in an instant. At the same time, glass door panels and fan lights will collapse by rapid expansion, and the intense heat entering rooms will cause them to burst into flames.

It is surprising how small an opening through a wall or floor will suffice as a gateway for superheated air to start a fire on the opposite side.

In a fire in a reinforced concrete investigated building at Far Rockaway, L. I., it was found that the fire entered the concrete building from an adjoining structure through a 4-in. hole in the concrete party wall, and then passed to two stories above by way of 2-in. holes in concrete floors where a heater pipe had been removed. At another place the hot air went through a 1-in. hole in the party wall and set fire to a wood pile!

National Board of Fire Underwriters.

The Biggest Engine in the World

(*Illustrated with copyrighted photographs by Underwood & Underwood, N. Y.*)

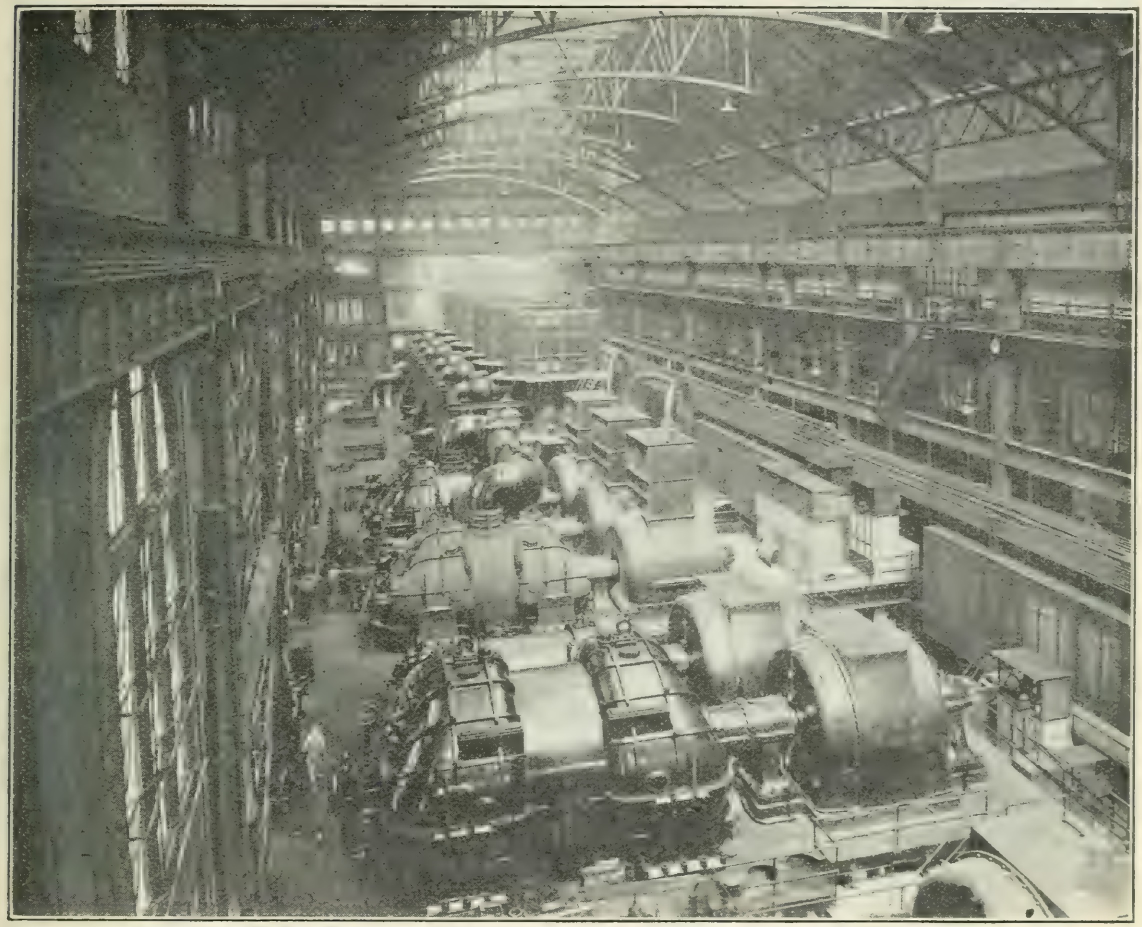


FIG. 1—THE BIGGEST ENGINE IN THE WORLD, IN CENTRAL FOREGROUND, HOUSED IN THE WORLD'S BIGGEST POWER HOUSE. GENERAL VIEW.

WE ARE fortunate in being able to present to Compressed Air Magazine readers in this issue the accompanying photographs showing the biggest steam engine in the world, housed in the world's largest power house, that of the Interborough Rapid Transit Company of New York, in East Seventy-fourth street. Here is generated power for the driving of the fast electric trains of the elevated, subway and surface lines of Manhattan, Brooklyn and the Bronx.

The Interborough is known as the greatest passenger-carrying railroad in the world and it is also proud to call itself, because of the multiplicity of its automatic devices and their results in usage, the "safest railroad in the world." In the rush hours of the morning and evening its ten-car steel trains roar through tunnels underneath the streets of New York at fifty miles an hour, each train hauling close to 2,000 persons, and running at times less than a minute apart.

The operation of the Interborough's great Subway system is regarded by transportation experts as a marvel of speed and efficiency, despite the handicap of crowds of passengers so great, and always growing, that it seems as though the company will never be able to keep pace with the increase in New York's population.

New Yorkers are prone to growl at the Subway, not because of the service, but because there are so many other New Yorkers who use it, but when anyone wants to get anywhere in Manhattan in a hurry, he takes the Subway. Every

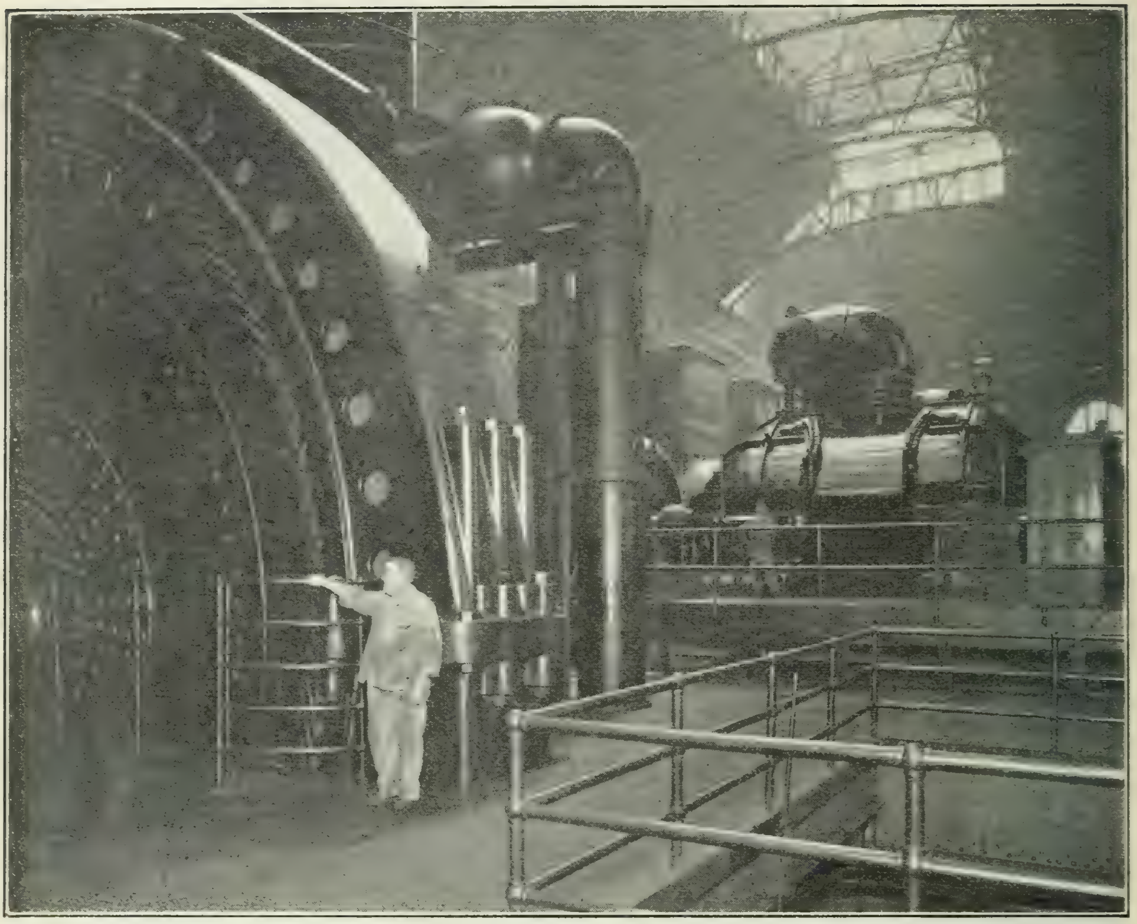


FIG. 2—THE OLD AND THE NEW. THE BIG ENGINE AT THE LEFT OF PICTURE IS OF 7,500 H. P. BEYOND IS THE BROBDIGNAGIAN 100,000 H. P. ENGINE.

hour of every day in the year its trains catapult the millions of the world's metropolis to and from business, to social affairs, the theatre, to weddings and funerals.

At three or four o'clock in the morning, to the amazement of visitors in New York, the trains seem to be as filled with hurrying people as in the daylight hours. It is considerable of a railroad that takes in one hundred thousand dollars a day in nickels. Incidentally one can ride all day in the Subway for a nickel if he wants to —but who wants to?—and can ride on a continuous trip of about thirty miles for a nickel, a reasonable enough cost for transportation.

Prior to the advent of prohibition upon these arid shores gentlemen were known to have ridden back and forth over the lines of the system several times in the small hours of the morning, before being sent on their way refreshed (from slumber) and rejoicing, by some kind-hearted guard. Who says the great corporations are soulless?

Our present concern is with only one of the Interborough company's power houses, a general view of which is to be noted in Fig. 1. In the foreground are to be seen the new steam turbines recently installed. The first is a 40,000 h.p. Westinghouse double compound turbine. Next beyond it is the largest engine in the world, the 100,000 h.p. Westinghouse triple compound turbine, the generators run by this engine being connected with the three air stacks. Further on in the picture are six 7,500 h.p. reciprocating engines with generators about thirty feet in diameter.

One of the old engines would weigh about as much as the triplex, which is more than twice as powerful as all six of the old engines. The

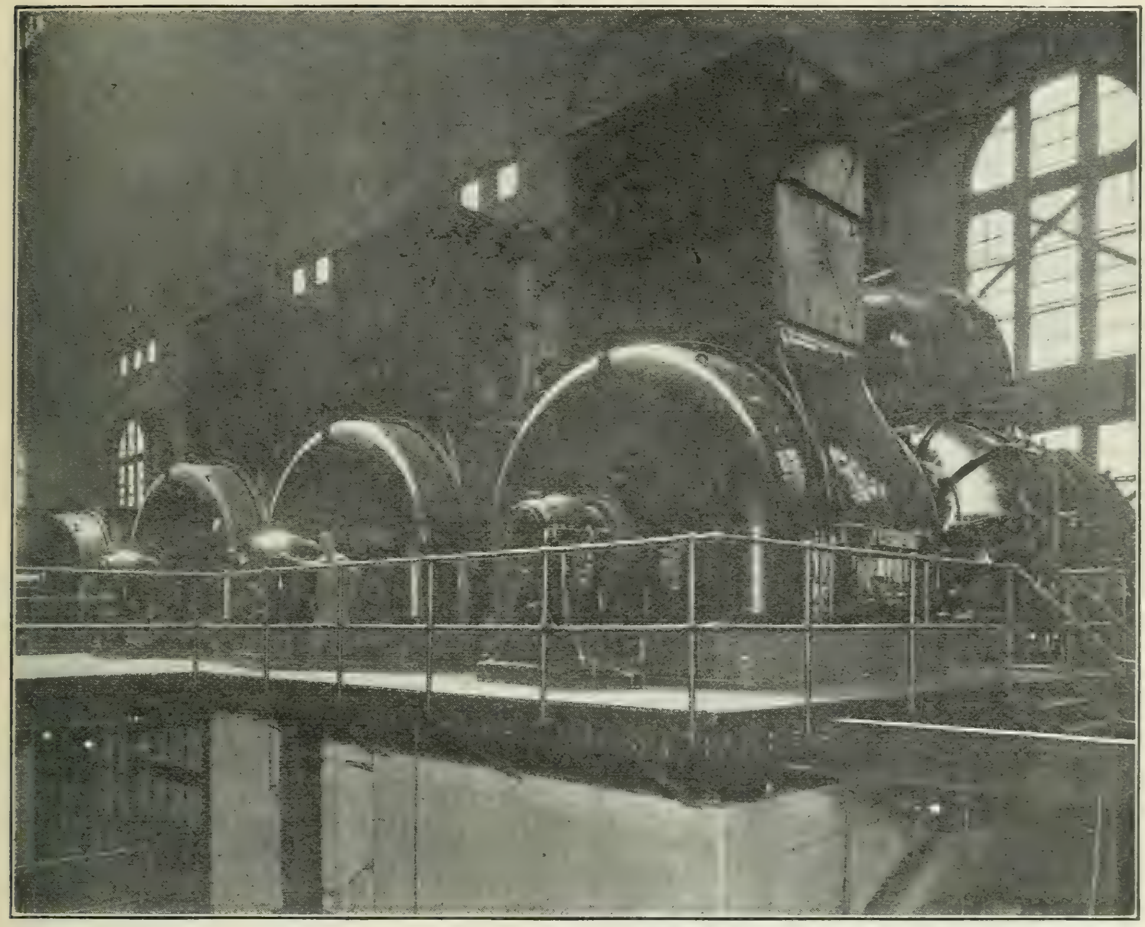


FIG. 3—THE THREE ELECTRICAL GENERATORS DRIVEN BY THE 100,000 H. P. STEAM TURBINE COLOSSUS. WASHED AND FILTERED AIR ESCAPES CONTINUOUSLY THROUGH THESE GENERATORS AND PASSES OUT THROUGH THE BIG STACKS. THESE GENERATORS ARE EACH AT 20,000 KILOWATTS CONTINUOUSLY AND AT 23,500 KW FOR TWO HOURS A DAY.

100,000 h.p. engine will alone generate enough electrical energy to run nearly half of the transportation lines of Manhattan.

The great turbine, a near view of which is seen in Fig. 5, consists of one high-pressure and two low-pressure elements, each connected to a separate electric generator. This gives it the appearance of three distinct machines, but it is actually a single unit and all three elements are started and controlled as one. The triple arrangement is employed because it is mechanically superior to the single element design for a machine of such great power. There is also a great advantage that in an emergency any one or two of the elements can be shut down without stopping the others.

This wonderful engine is far less spectacular in appearance than the old 7,500 horse power engines in the same room, but it has a massiveness that bespeaks tremendous power within.

The difference in size is due to operating principles. The reciprocating engine consists mainly of a cylinder in which the piston is pushed up and down by steam. The main parts of the turbine, on the other hand are a spindle, carrying hundreds of small vanes, and a casing which encloses the spindle. The steam, acting upon the vanes of the spindle, revolves it as the wind revolves a windmill.

The motion of the turbine is rotary and as there are no heavy parts to be stopped and started at the end of every stroke as in a reciprocating engine, very high speeds are permissible, thus making it possible to develop great power from

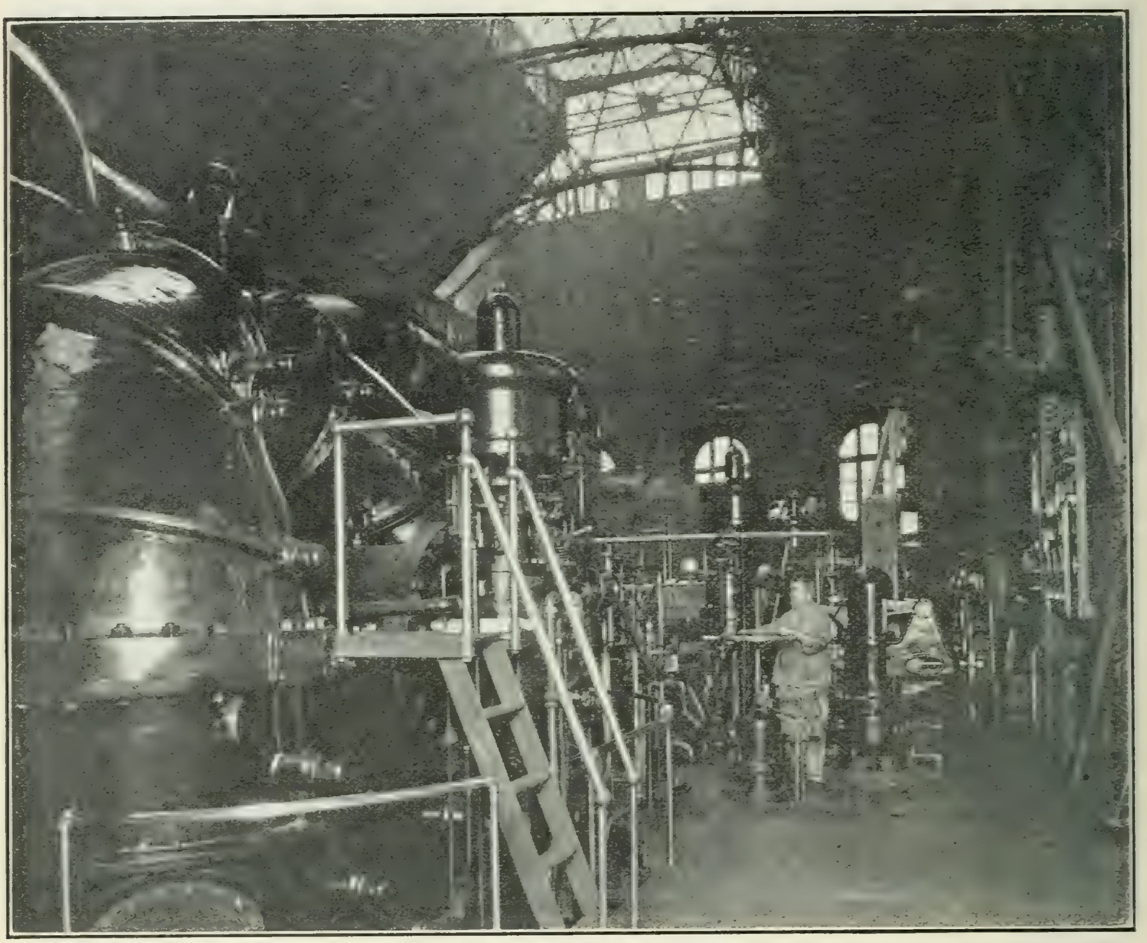


FIG. 4—GOVERNORS AND CONTROLLING MECHANISM OF THE GIANT ENGINE. THE GOVERNORS CONTROL AUTOMATICALLY THE OUTPUT OF THE MACHINE AND PREVENT OVER-SPEEDING. NOTE THE LOFTY CEILING OF POWER HOUSE AS INDICATED BY THIS PICTURE.

a comparatively small machine. The speed of this 100,000 horse power turbine is 1500 revolutions a minute.

Superheated steam enters the high pressure element at 205 lbs. pressure and, dividing into two portions, is exhausted into low-pressure elements of 15 pounds pressure. From the low pressure elements it goes into the condensers in which a 29-inch vacuum is maintained. Eight hundred and twenty-six thousand pounds of steam are used per hour for a maximum load, and the water rate is below 11 pounds of steam per kilowatt hour. The generators, as noted in Fig. 3, are each rated at 20,000 kilowatts continuously and at 23,500 kw. for two hours. Three-phase, 25-cycle current at 11,000 volts is delivered to the substations. The floor space covered by the big turbine is 52x50 ft. Its height is about 20 ft.

LARGE CONCRETE PIPES FOR WATER, GAS AND AIR

One of the most suggestive and significant signs of the times in the engineering field is the recent decision of the Birmingham (Eng.) authorities to use concrete pipes for their water main 35 miles long and 5 feet in diameter. The fact that Birmingham is a great center of the iron and steel industry makes this decision the more surprising. It seems more than probable that this example will be followed by other municipalities, and that concrete piping will be coming into extensive use not only for water but also for gas and compressed air.

We note a plane but paradoxical truth about the airplane to the effect that it is not much good unless it is used up.

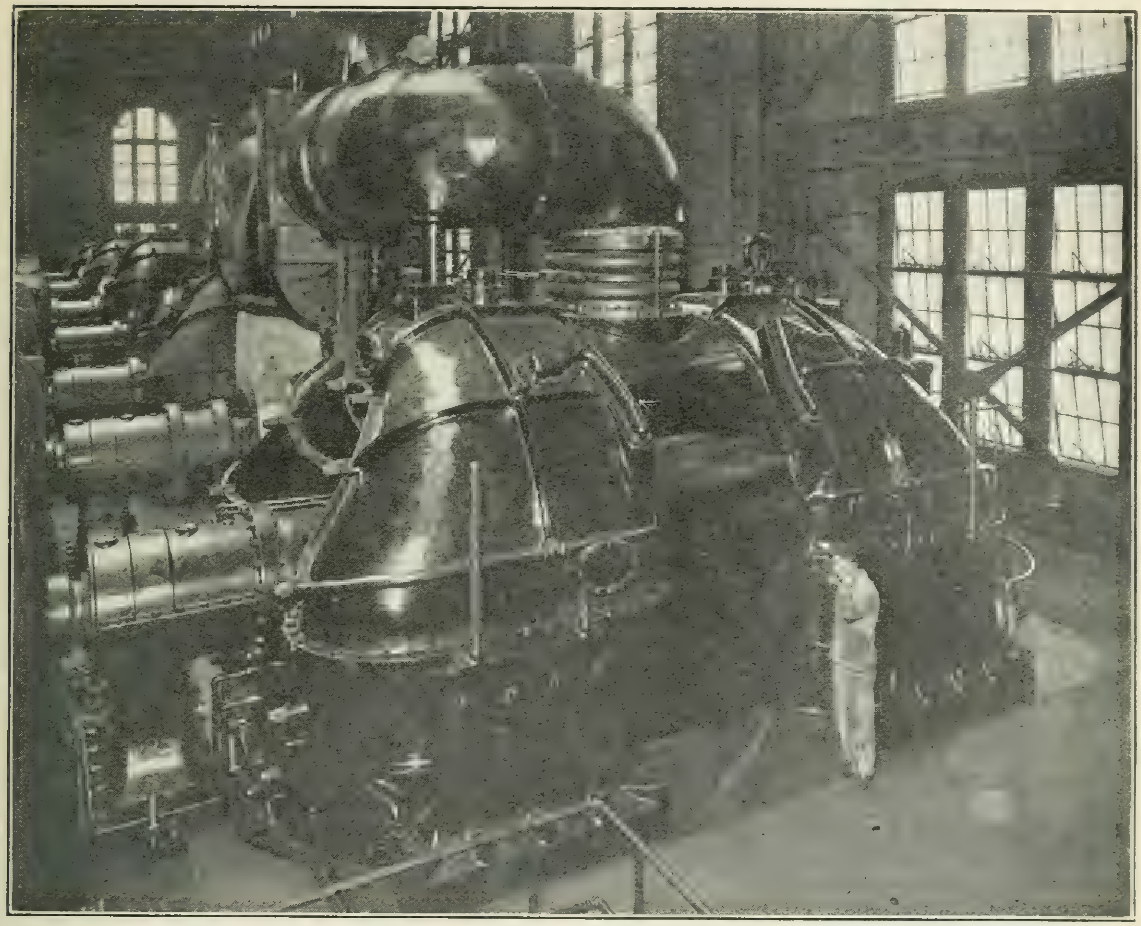


FIG. 5—A "CLOSE UP" VIEW OF THE 100,000 H. P. E LECTRICITY-GENERATING MONSTER. SEE TEXT FOR DETAILS.

DEFECTIVE HOSE COUPLINGS

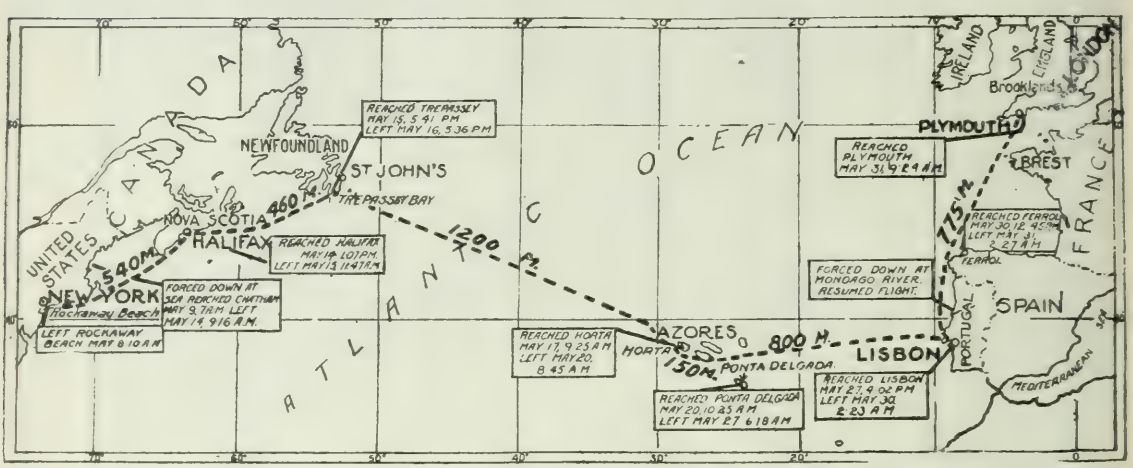
At the recent annual meeting in Chicago of the Air Brake Association, a paper on Air Leakage and Money Wasted, etc., called attention to the fuel waste due to brake pipe and leakage. It was stated that examination of 1,000 freight cars showed that 35 per cent. of the leakage existed in the hose couplings. Further investigation developed that it was difficult to find couplings in service that would pass the M. C. B. standard coupling gage test. Employees often use makeshifts to secure tight joints, and at least one road has adopted a special gasket to eliminate hose coupling leakage. Some special types of gaskets submitted to railroads for approval when tested have required from 1,000 to 1,300 lb. to pull the hose apart. Such excessive strains fracture the hose and cause the brake pipe to shift, resulting in leakage. The paper recommended that the universal practice of gaging air brake hose couplings be included when periodic attention to air brake equipment is being given freight cars in shops or on repair tracks.

Emil Swensson, one of the pioneer designers to whom is accredited the success of the steel hopper car, died in Pittsburgh recently. His first work on coming to the United States in 1881 was on the construction of the old Hudson River railroad tunnel. The following year he became topographer and assistant engineer for the South Pennsylvania R. R., now a part of the Pennsylvania system. Shortly thereafter he became identified with the bridge building industry of Pittsburgh, continuing in that and related lines in an official capacity for many years.

The Finish of the New York-Plymouth Flight

A Climax of 20th Century Transatlantic Feats

By HAVELOCK C. HISLOP


CANADA
UNITED STATES
NEW YORK
Rockaway Beach
LEFT ROCKAWAY BEACH MAY 8 10 A.M.
FORCED DOWN AT SEA REACHED CHATHAM MAY 9, 7 A.M. LEFT MAY 14, 9.16 A.M.
540 M.
NOVA SCOTIA
HALIFAX
REACHED HALIFAX MAY 14, 1.07 P.M. LEFT MAY 15, 11.47 A.M.
460 M.
NEWFOUNDLAND
ST JOHN'S
TREPASSEY BAY
REACHED TREPASSEY MAY 15, 5.41 PM LEFT MAY 16, 5.36 PM
1200 M.
ATLANTIC OCEAN
AZORES
HORTA
REACHED HORTA MAY 17, 9.25 A.M. LEFT MAY 20, 8.45 A.M.
150 M.
PONTA DELGADA
REACHED PONTA DELGADA MAY 20, 10.25 A.M. LEFT MAY 27 6.18 A.M.
800 M.
LISBON
REACHED LISBON MAY 27, 9.02 PM LEFT MAY 30, 2.23 A.M.
PORTUGAL
SPAIN
MEDITERRANEAN
FORCED DOWN AT MONDAGO RIVER. RESUMED FLIGHT.
FERROL
REACHED FERROL MAY 30, 12.45 P.M. LEFT MAY 31, 2.27 A.M.
775 M.
BREST
FRANCE
PLYMOUTH
REACHED PLYMOUTH MAY 31, 9.24 A.M.
IRELAND
ENGLAND
Brooklands
LONDON
70°
60°
50°
40°
30°
20°
10°
0

(Map by courtesy of *The New York Times.*)

THE AERIAL ROUTE OF THE NC-4 ON HER MEMORABLE TRANSATLANTIC JOURNEY.

JUST AS WE all felt certain he would, Lieutenant Commander Read of the United States Navy, completed on May 31 the last legs of his epoch-marking aerial journey from New York to Plymouth, England, by successfully negotiating the trip from the Azores to Portugal and thence to the port from which the Pilgrim Fathers sallied forth for America early in the seventeenth century. He won the plaudits of the world and was showered with honors in Lisbon, Plymouth, London and Paris, as were the men of his gallant crew.

Read took premier honors as the first transatlantic aerial navigator, but his fine feat was quickly followed by the non-official achievement of Captain John Alcock, pilot, and Lieutenant Arthur W. Brown, his American navigator, who flew in a Vickers-Vimy biplane from Newfoundland to Clifden, Ireland, in a non-stop flight of sixteen hours and twelve minutes, landing June 15. Alcock and Brown flew through dense fog most of their journey, and for many hours saw nothing of sun, moon or stars. They found themselves unwittingly looping the loop, flying upside down only ten feet above the water, and for four hours the machine was covered by a sheet of ice, caused by frozen sleet.

Captain Alcock flew at two miles a minute, without accident, rising at times to a height of 11,000 feet. Brown's skilful navigation of the machine, in bringing it near to the center of the Irish Coast line, was a fine feature of the flight. Landing in a bog near the Clifden wireless station, Brown was dazed and temporarily deafened Alcock. Only two-thirds of the fuel supply was used. Captain Alcock declared, as a result of his flight, that the flying boat was the solution of transatlantic aerial travel, a reasonable deduction. To return to consideration of Commander Read's exploit:

The entry of the NC-4 into Plymouth was described as magnificent. Nothing could surpass the grace of her high, steady flight as she flew around the harbor before coming to rest like a gull on the surface of the water. Her men were welcomed by Plymouth's mayor at the Barbican, the very spot from which had set sail the historic *Mayflower* three centuries before. Kings, premiers and presidents vied with one another in doing honor to the pioneer aerial navigators of the Atlantic. President Wilson wired his congratulations and later received Commander Read at Paris. Portugal decorated the aviators with the Grand Cross of the Order of the Tower and Sword, over all of which the Navy Department and the American people were happy and proud.

Generous praise was accorded the Americans by the sportsmanlike British press, which had naturally been hoping that Hawker and Grieve would make the riffle. The safe arrival of the latter pair, after their unfortunate experience on their attempt at a direct crossing in their small land plane, and following a week of anxiety during which there was despair for their safety, was the signal for a great British demonstration in honor of their daring and courage, but which did not prevent the English people from giving voice to such expressions as the following, which appeared in the London *Observer:*

"The romantic appeal of Hawker's desperate attempt somewhat overshadowed the businesslike success of Commander Read. The very certainty and regularity of the American flight have impaired popular appreciation of its true worth as a scientific achievement, and as an example of the irrepressible spirit of venturesome humanity.

"The flight is a tribute to the quality of the machine and the efficiency of an organization, but above all to the courage, endurance and skill of the pilot.

"America wins the first honors upon the transatlantic airways. Commander Read's arrival gives us opportunity for enthusiastic acknowledgment of the service that he and his country have rendered to the Old World and the New in first linking them up by air."

One of the pilots of the NC-4, Lieut. Commander Walter Sinton, described the last part of the long journey by air.

"We came down at the Mondega River," he said, "because we had a leak in a water jacket and were afraid it was a leak in the oil tank. In itself it was of little importance, but if it had been in the oil tank it would have been impossible for us to continue the flight. Our only reason for delaying overnight was the impossibility of rising from the river we landed in until the tide flowed in again.

"We left Ferrol next morning and had favorable conditions until off Brest. There we ran into fog, and had to come down sometimes to only 50 feet altitude to find our way. Generally we were flying at 1,500 feet, but sometimes went up to 2,000."

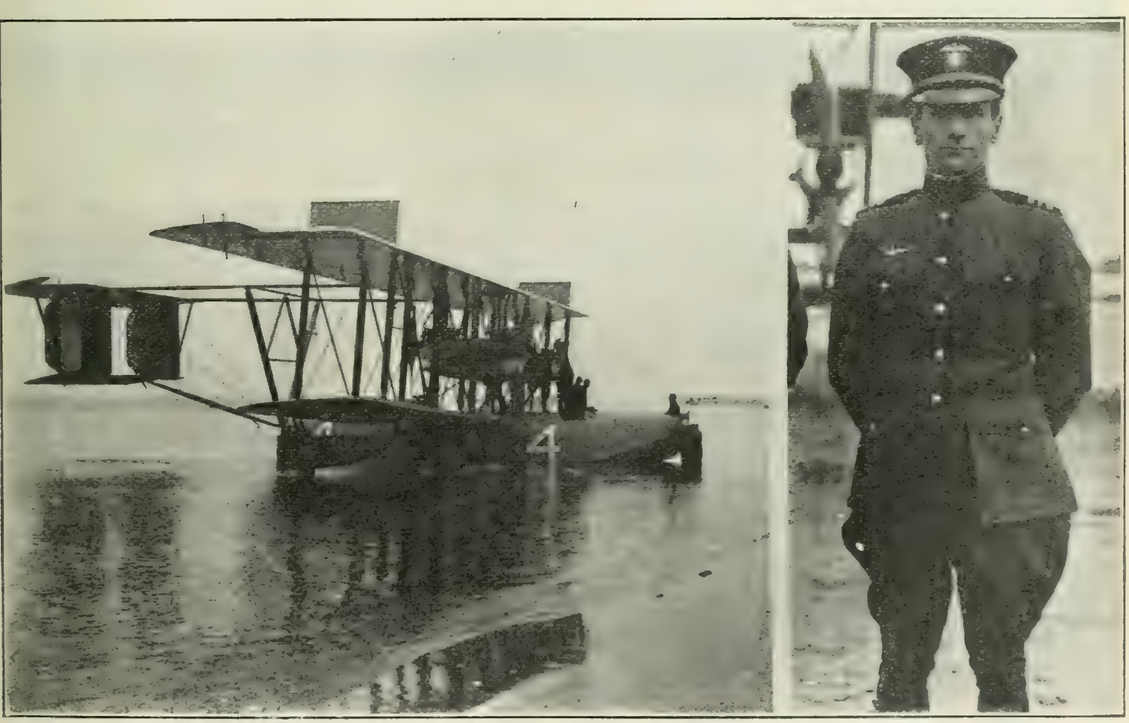
The visit to Brest was somewhat unexpected there, as it meant a slight detour. It gave rise to an interchange of messages between Commander Read and the American Admiral. Then Read wirelessed by way of the George Washington:

"Greetings from NC-4. I am sorry I cannot stop."

The Admiral replied by the same route:

"Congratulations on your magnificent flight. Sorry you cannot stop and let us entertain you. Good luck."

The passage had been so smooth from the Azores to Lisbon that the crew actually had a comfortable shave in the final hour. Only the start had been difficult—difficult and anxious.



(Copyright, Underwood & Underwood, N. Y.)

THE WORLD-FAMOUS NC-4 AND HER SKIPPER, LIEUTENANT COMMANDER ALBERT C. READ.

(Copyright, Underwood & Underwood, N. Y.)

THE HANDLEY-PAGE MACHINE, KNOWN AS THE "BERLIN BOMBER," AT NEWFOUNDLAND IN READINESS FOR TRANSATLANTIC FLIGHT.

With vexation they described the seven days' wait for the wind to fall that was sending rollers ten to fifteen feet high right into the mouth of the tiny harbor of Ponta Delgada.

"There was no room to rise in smooth water," said Commander Read. "We simply had to wait for a calm or buck those rollers."

In point of fact, they did the latter. The sea had fallen slightly, but it was still dangerously high. But they could bear it no longer.

"We just gave her a run and pulled her nose up," said Pilot Sinton, "and she rose like a bird. It was right at the harbor mouth, and believe me, it was rocky there among those waves. But our luck held all right, and after that it was easy."

Though the sky was cloudless, a haze had prevented them from seeing the patrol boats until they were almost atop of them, but nevertheless they hardly varied a jot from their course.

"As long as there are no clouds it's all right," said Commander Read. "You can just sit still and let her go. The first European land we sighted was the sandbanks off the mouth of the Tagus, shining golden at the dead low tide in the setting sun. Then we met the Portuguese planes, and picked up the hills north and south of the river, then the river mouth itself, and the city and the steam cloud between the masts of the *Rochester* and the *Shawmut's* searchlights."

The airmen complained of deafness as the result of the ten hours' thundering of the motors. They were not tired, they said—although more than one face looked haggard under its tan—but they were hungry.

"We ate some chocolate and sandwiches during the trip," said one, "but will be glad of a square meal."

They got their square meal and a good sleep and then followed preparations for a final getaway to England. The newspapers have been filled with pages of descriptive matter on the other popular aspects of the flight, which it is unnecessary for us to consider here.

The NC-4 in its flight from Rockaway to Plymouth covered a distance of 3,925 nautical miles in 57 hours and 16 minutes of actual flying time. This represented 3,436 minutes of actual flying time, or an average speed of 68.40 knots an hour. The best average speed and performance over a sustained distance was the complete ocean flight of 2,150 miles from Trepassey to Lisbon, which was made in 26 hours and 47 minutes, and represented an average speed of 80.8 knots an hour. The general flight record of the NC-4 in detail follows:

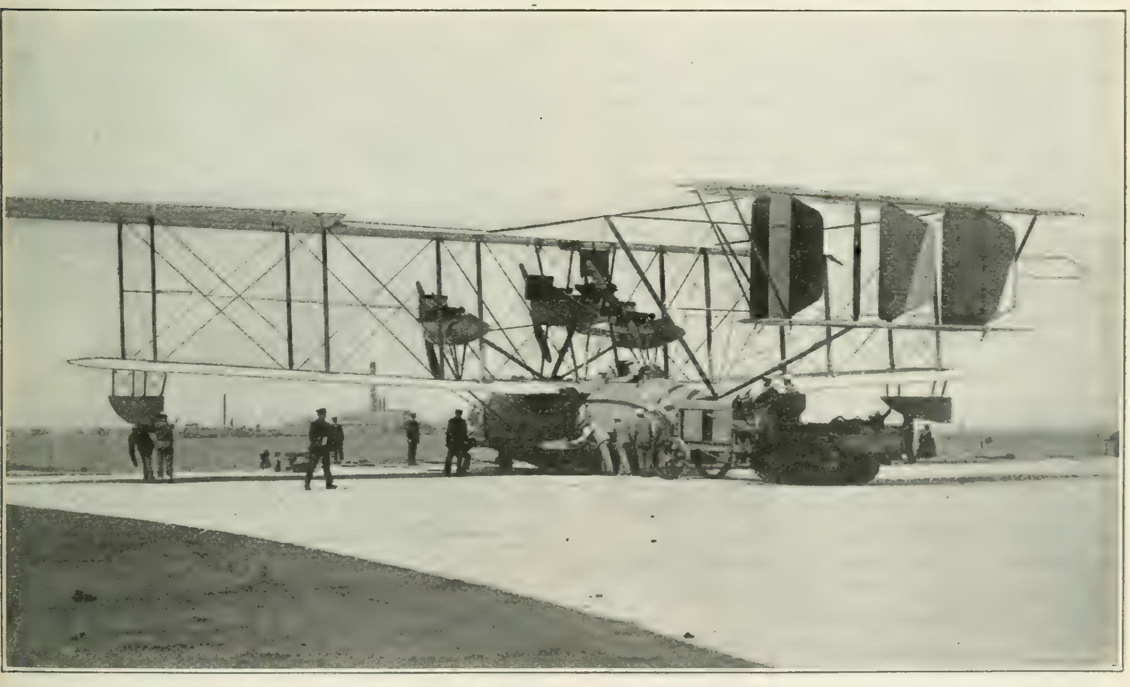
Course.	Date.	Naut. Miles.	Time.	Speed Knots.
Rockaway - Chatham (forced landing about 100 miles off Chatham)	May 8	300	5:45	52.0
Chatham - Halifax	May 14	320	3:51	85.0
Halifax-Trepassey	May 15	460	6:20	72.6
Trepassey-Horta	May 16-17	1,200	15:18	78.4
Horta-Ponta Delgada	May 20	150	1:45	86.7
Ponta Delgada-Lisbon	May 27	800	9:44	88.1
Lisbon-Mondego River	May 30	100	2:07	48.8
Mondego River-Ferrol	May 30	220	4:37	45.6
Ferrol-Plymouth	May 31	455	6:59	64.8
COMPLETE FLIGHT ROCKAWAY TO PLYMOUTH				
Rockaway to Plymouth	May 8-31	3,925	57:16	68.4
COMPLETE OCEAN FLIGHT				
Trepassey to Lisbon	May 16-27	2,150	26:47	80.3

A feature of the apparatus with which the NC seaplanes were equipped for safety and communication, and which I was unable to consider in my article of the June issue of COMPRESSED AIR MAGAZINE, was the wireless. Communication by wireless from an airplane, to me, is one of the most wonderful things in a wonderful world, and my interest is not that of a layman, either, for I was for years in the wireless telegraph business with what was at one time the greatest American radio company.

The radio on the NC planes involve two transmitters, we learn from the Navy authorities. One is a one-half kilowatt spark transmitter, the main element of which is a streamline generator and accessory apparatus which is driven by an air propeller and is mounted on the deck of the boat aft. This set weighs only forty-five pounds, but is used for the regular telegraph communication between the seaplanes and stations up to a distance of 250 nautical miles. Since this set is driven by a propeller, it can only be used while seaplanes are in flight.

The antenna used for this set is a single trailing wire leading from the tail of the boat for a distance of 250 feet down and to the rear.

A streamline lead weight holds the lower end of the wire down. With this transmitter it was possible for the commanding officer to send messages from time to time regarding the progress of the flight, to be retransmitted by the nearest shore station to the Navy Department at Washington. Also communication could be held with



(Copyright, Keystone Photo News, N. Y.)

TRACTOR USED FOR LAUNCHING AN NC TYPE SEAPLANE. THIS VIEW SHOWS THE NC-3, WHICH WAS CONSIDERABLY DAMAGED IN THE HEAVY SEAS WHEN IT ALIGHTED ON THE WATER NEAR THE AZORES IN A FOG, BUT CAME INTO THE HARBOR UNDER ITS OWN POWER BY "TAXI-ING" ON THE SURFACE.

destroyers and other craft and compass signals or other information requested.

The other transmitter is a combined telephone and telegraph transmitter, and operates on a small 12-volt storage battery. It is used on antenna consisting of wires permanently stretched on the skid fins on the upper planes so that it may be used while the seaplane is in flight or on the water.

It is this set which was used for telephoning between the three planes which flew to the Azores, arrangements having been made so that either the radio operators or the commanding officers themselves might communicate directly by telephone while the planes were in flight. Such interplane telephoning may be carried on up to a distance of twenty miles. While on the water this set may be used for telegraphing or telephoning a distance of about thirty miles.

A special feature of the telephone set is the anti-noise microphone, which is so constructed that the engine noises are not heard. This is accomplished by having the back of the microphone open. The exterior sound waves strike the back as hard as the face of the diaphragm, and therefore the effect is neutralized. The voice waves strike only the face of the diaphragm, and even though the operator cannot hear his own voice, the radio set receives enough effect to modulate the transmitted wave.

Lack of space prevents me from making all the comment and touching upon all the points I should like to make in this article regarding the American Navy's great feat. It was an achievement that will carry the name of Read of New Hampshire down in history with the names of other brave and steadfast men who gained fame as venturesome pioneers and discoverers. Read will always have an honored position on the rolls of the American Navy as the first officer to cross the Atlantic in a ship of the air, and science will perpetuate his name, without doubt, for the world is the richer for the scientific data he and his mates gathered on their celebrated journey.

Read's was another feat that made Transatlantic history. His trip was a climax to a book of human achievements it took many centuries to write. Eric the Red may have written the first chapter nearly 1,000 years ago.

Columbus sailed across the unchartered Atlantic in 1492 with incalculable results to the world.

Cabot first crossed the North Atlantic in 1497.

The first steamship crossed in 1819.

The first cable was laid in 1858.

But the twentieth century begins with four great exploits, constituting scientific strides that outstrip all previous achievements:

The first wireless message was flashed across the Atlantic in 1901.

The first submarine crossed the Atlantic in 1916.

The first wireless telephone spoke across the Atlantic in 1919.

The first Transatlantic flight was made in 1919.

We live in an age of wonders of air, land and sea.

The Chicago Pneumatic Tool Co. has announced the appointment of Allan E. Goodhue as managing director of its English subsidiary, the Consolidated Pneumatic Tool Co., Ltd., whose offices are at 170 Piccadilly, London, and whose plant is in Fraserburg, Scotland. Mr. Goodhue will also be in charge of European sales for the Chicago Pneumatic Tool Co. Mr. Goodhue was for a number of years connected with the sales department of the Midvale Steel Co. and Midvale Steel & Ordnance Co. in Philadelphia, Chicago and Boston, leaving that company in March, 1918, to enter the service of the Government. From that time until Jan. 1, 1919, when he became connected with the Chicago Pneumatic Tool Co., he was assistant manager of the steel and raw material section, Production Division, of the Emergency Fleet Comporation.

A new technical society is being organized to be known as the American Welding Society in which will merge the Welding Committee of the Emergency Fleet Corporation and the National Welding Council. Its purpose is to form an organization that will become a disinterested and dependable form of information on welding, and serve the interests both of the users of welding apparatus and the manufacturers of such apparatus and welding supplies. The address is, American Welding Society, 33 West 39th street, New York City.

Charles S. Cunningham, a member of the Michigan Railroad Commission since 1913, who was formerly connected with the Wabash Railroad, and then with the Grand Trunk R. R., after its reorganization in 1896, died recently at Lansing, Mich.

Prof, William H. Dorsey, head instructor of foundry practice at Carnegie Institute of Technology, Pittsburgh, has been appointed assistant in the training method section of the United States training service. This service is under the Department of Labor. Mr. Dorsey is a native of Sheboygan, Wis.

Survey of the Technical Field

Edited by FRANK RICHARDS

Application of the Sand Blast

*By H. D. GATES**

FOR THE average jobbing foundry, where the work runs promiscuously from small to large and the daily output is not large enough to permit of specialized equipment, no type of machine so effectually accommodates itself to all kinds of work as the high-pressure hose sand-blast.

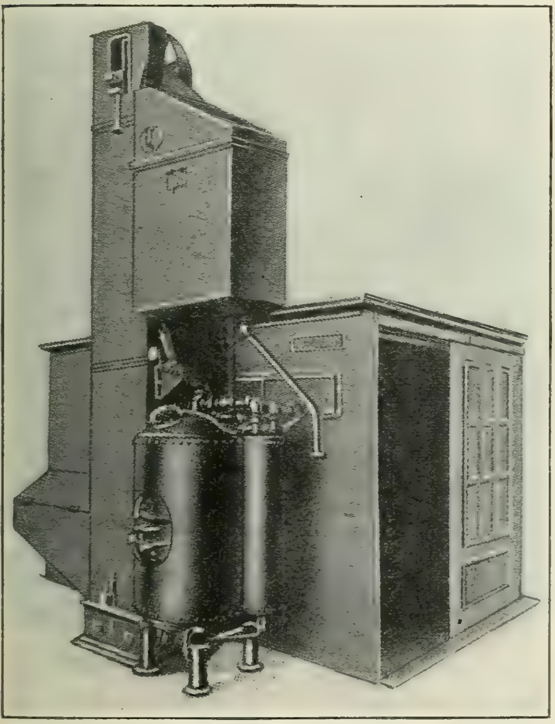


FIG. 1—MECHANICAL AND EXHAUST SCREEN SEPARATOR PERMITS REUSE OF WARMED AIR.

The hose type machine was the first method of application of sand-blasting, and consists of a sealed container into which the sand or other abrasive is loaded, and by direct air pressure driven through a hose of required length, the air and abrasive being discharged in combination through the opening of a small nozzle. As no expansion of the air takes place before discharge at the nozzle, the greatest velocity of the abrasive is obtained by this method, with corresponding effectiveness of abrading action. The high-pressure sand-blast is now recognized as the standard for general foundry use.

EFFECT OF AIR PRESSURE ON ABRASIVE ACTION

While the travel of compressed air through a pipe or hose is approximately the same at all pressures above one atmosphere, the velocity of the abrasive after leaving the nozzle increases very rapidly as the air pressure is increased, with correspondingly greater blasting effectiveness. This permitted the use of small, easier handled hose and small nozzle, in place of the large, cumbersome hose and nozzle, with a very decided saving in labor to the tonnage cleaned. Better operating conditions were obtained also through reduction of dust created by disintegration from the lesser volume of sand used. Some better understanding of this will be possible from the results of tests made. These show that the amount of sand blown at 30-lb. pressure to remove 1 lb of metal from an iron bar was 3361 lb., while at 70-lb. pressure the required sand was but 2043 lb., or over 50 per cent. more at the lower pressure, the same size nozzles being used in both instances. Of the reusable sand there is only 17.2 per cent. difference in favor of the lower pressure.

The amount of metal removed per 100 cu. ft. free air per min. flowing was, at 30-lb. pressure, 0.1969 in., and at 70 lb., 0.4473 in., or nearly two and one-half times as much accomplished at the higher pressure, with no increase in time and labor.

AIR CONSUMPTION

The amount of air consumed in sand-blast operation is governed entirely by the size of the nozzle opening and the pressure maintained; this feature is therefore one that should have the most careful consideration of the prospective sand-blast user. Constant wear, varying with pres-

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**Abstract from an address before the Newark Foundrymen's Association by Mr. Gates of the Pangborn Corporation, Hagerstown, Md.*

sure and abrasive, is occasioned in the nozzle, and a very little enlargement means considerable increase of air consumed and horsepower as well.

For instance, a nozzle with ¼-in. opening flows 76 cu. ft. of free air per min. at 70 lb. pressure, as in the sand tests above, requiring 12.7 hp. to develop. Increase this opening 1/32 in., and the air flow increases to 85.5 ft., or 12.5 per cent., and horsepower requirement is 14.3. An enlargement of 1/16 in. increases the air flow to 118 cu. ft., or 16.5 per cent., with horsepower developed 19.9. And if the increase reaches ⅛ in. the air flow jumps to 171 cu. ft., or an increase of 125 per cent., while the horsepower developed rises to 28.6. If this wear, therefore, can be eliminated, obviously much power expense will be saved as well as constant pressure maintained.

The construction of the modern sand-blast room is sheet steel made dust-tight, with fresh air inlets around the sides near the base, the dust-laden air being carried off through a hood in the ceiling of the room by a powerful exhaust fan. The volume of dust created will be governed by the character of work cleaned, that is, whether plain surfaces to which little sand adheres, or intricate shaped pieces from which cores must be blasted; also whether sand or metal abrasive is used, and, if sand, its friability.

Constant change of air should be provided as the character of the work may demand. The natural tendency of the dust is to rise, and this is aided by the intake of the air at the base of the room and its drawing off through the ceilinig.

Electric light fixtures are provided, with white enameled reflectors, set into the ceiling of the room and covered with discoloid fronts to protect the lamps from flying abrasive. Ventilation and free observation of the work being so essential to quantity production, these features should not be slighted.

The room can be equipped as the demands of the plant and its output require. Large, heavy castings should be loaded at the molding floor on to grated top cars, the track extending into the sand-blast room and the pieces cleaned on the car without unloading. If the plant is equipped with a monorail this too can be extended into the room and the pieces cleaned while hanging without other handling. For small work a grated top bench can be provided where convenient, and for very small pieces much economy will be found in cleaning on the grates, it having the advantage of saving on tools and giving, without extra time and cost, clean scrap which is particularly advantageous and even necessary in the use of some types of electric furnace.

HYGIENIC ROOMS

The trend toward hygienic rooms that entirely remove the operator from the sand-blast inclosure has developed devices of different types that meet every demand. The hygienic room is provided with a sight screen on four sides through which the operator may see his work, while below this is a nozzle slot or opening, closed by sectional flexible curtains, through which the operator directs the nozzle on the work to be cleaned. While this permits the operator to work in the open and without other protection than afforded by the room, ventilation is necessary that the created dust may be rapidly removed so as not to obstruct illumination and free observation of the work.

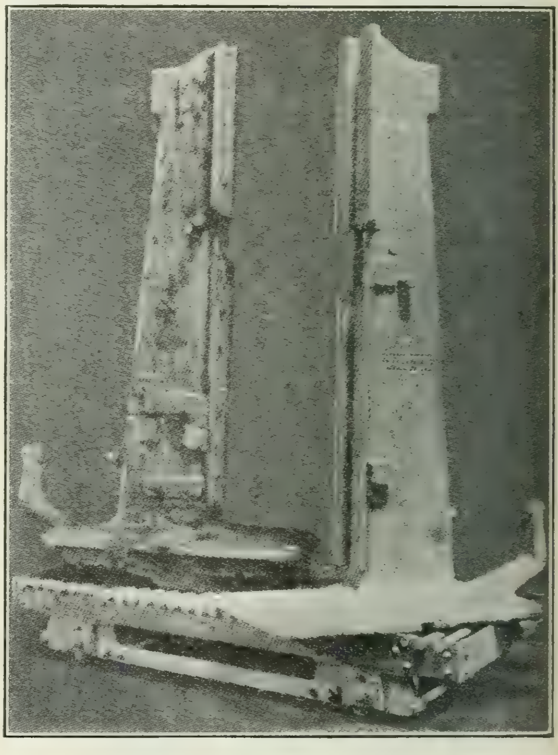


FIG. 2—CASTING FOR MACHINE TOOL BEFORE AND AFTER SANDBLAST.

Rooms of this nature are more adaptable to work of rather uniform size, as the width and length of the room should be such as to bring the work reasonably close to the nozzle slot on all sides and keep ventilation requirements at the minimum. These rooms are particularly adaptable to large and heavily cored work, and for cleaning long lathe beds and other work of this nature, and are usually constructed of a length to receive a little more than half the longest piece, with the other half extending through the curtains closing one end of the room, the pieces being reversed for cleaning the other half. In this way pieces 20 to 30 ft. long are readily cleaned in a room of size but little more than half their length.

For the plant that has a tonnage of small work sufficient to warrant special equipment, the barrel sand-blast or the rotary table sand-blast, or both in combination, will be found time and money savers. These units are self-contained, the spent abrasive falling through perforations in the drum and delivered to a hopper, from where it is raised by an elevator, cleaned and screened, and delivered by gravity to the nozzles for reuse automatically. In this type of barrel the interior of the drum is entirely unobstructed, and it will receive pieces up to the limit of the door opening size. Plow points are typical work for a barrel of this type. Other barrels of the suction type have a manifold running through the center with a series of nozzles and as the abrasive falls through the drum perforations it is passed through a series of screens to feed boxes from where it is raised by suction to the nozzle, and in combination with the air projected onto the work. Barrels of this type are more efficient for smaller pieces, such as valve bodies and the like, and from which they will remove the cores.

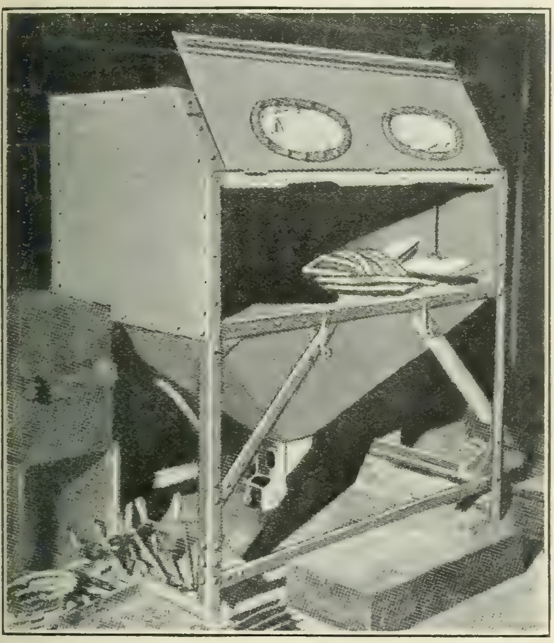


FIG. 3—SANDBLAST CABINET FOR BRASS WORK.

There is, as much advantage in the cleaning of brass or aluminum castings with the sand-blast as in the ferrous metals and cleaned on the the gates means economy of time and labor with thoroughly cleaned scrap. For the small jobbing brass foundry a self-contained unit in the shape of a sand-blast cabinet meets the requirements from every point of view. The initial cost is not large, floor space required is small and being of the suction type, is self-contained and continuous feeding as well as hygienic, the operator not being exposed to the dust-laden air.

Being simple of manipulation, they can be operated by unskilled or boy labor. These machines are made in various types and sizes, the one illustrated here being 3 ft. wide by 2 ft. deep, with a door opening 10 in. high. Pieces to be cleaned are laid on the grated floor of the cabinet and the operator handles the pieces through arm holes equipped with rubber gloves and canvas gauntlets, seeing the work through a wire and glass-covered opening provided for the purpose.

DUST ARRESTERS

For suppression of the dust created, the simplest arrangement is settling chamber with baffles that retain the heavier particles, and even this device is found satisfactory only in widely separated plants and where the operations of the foundry do not include machine work.

Where absolute suppression of the dust is not demanded, the centrifugal dry process arrester has been found highly efficient. From 90 to 95 per cent. of the created dust is retained in the arrester and discharged through the bottom to a receptacle from which arrangement for removal can be made as desired.

Where, however, entire suppression of all dust is required the cloth screen type of arrester is necessary. This is a steel case in which are located a series of specially woven cloth screens, the dust-laden air entering on one side, the screens retaining all dust and permitting passage only of the cleaned air which is drawn out the opposite side through the exhauster. A decided saving has been made in a great many plants through the use of this cleaned air which, being warm, can be returned into the plant ventilating system or directly to the sand-blast room, as conditions may warrant.

So effective are these arresters that by their use sand-blasting has been possible in large city office buildings and the diverting of the clean, warm air to plant ventilating systems has saved much in fuel where this has been done.

ABRASIVES

With the progress in sand-blast equipment and methods has come also progress in the matter of abrasives. Various classes of sand are now mined and graded for sand-blast use, and with the abrasive, as with the equipment, the better the quality the greater the economy and efficiency. The sand which is hard, sharp, clean, with the least disintegration, not only shows longest life and highest abrasive quality, but creates less dust. River or bank sands are rarely economical, even at lowest first cost. Ocean sands are quite satisfactory, but undoubtedly the white silica sands where available are most desirable. In fact, by their hardness and uniformity they would undoubtedly prove most economical at a considerably higher first cost.

Metal abrasives in the form of chilled shot, crushed steel, etc., are produced by different manufacturers, each making claims for their superiority. Of the life of the metal abrasives over sand there can be no question and this will range from 20 to 60 times. Disintegration is at the minimum and almost no dust is created from the metal abrasive itself.

In this connection, however, the much higher first cost demands an absolutely tight enclosure throughout, as any daily loss, even though small, will soon wipe out the saving in efficiency.

The selection of sand or metal abrasive will present several features for consideration. If the work to be cleaned is reasonably free from sand, considerable advantage in operating conditions will be found by use of the metal abrasives owing to their creating practically no dust by their own disintegration, but if the work is cored or carries a large volume of sand the advantage from the metal abrasives in this connection will, obviously, be greatly decreased, and the dust created by the disintegration of the blasting sand itself will not materially increase the dust volume arising from the castings.

Where pieces are to be galvanized or plated some complaint has been registered against the metal abrasives in that the fine metallic dust adhering to the pieces prevented satisfactory results in plating, but for general foundry output the character of the work itself with the delivered cost of the various abrasives will readily determine the economy of one over the other.

All of the modern sand-blast devices operate with equal facility with either sand or the various metal abrasives.

The water power of Brazil is about ten times as great as that of Canada. That is to say, Brazil could generate about 1,000,000,000 (how the billions are coming into fashion)! horse power from her rivers. The falls of Paulo Alfonso, near the outlet of the San Francisco River, between Bahia and Pernambuco, are alone reckoned to be equal to Niagara.

SUPERCHARGING THE AIRPLANE ENGINE

When actual flight by a machine heavier than air was first achieved the feat was hailed by the world as the successful solution of one of the great problems of the ages, which, indeed, in a way it was, but in fact it was also the propounding of an unending series of other most difficult problems which challenge the ingenuity of the world's inventors.

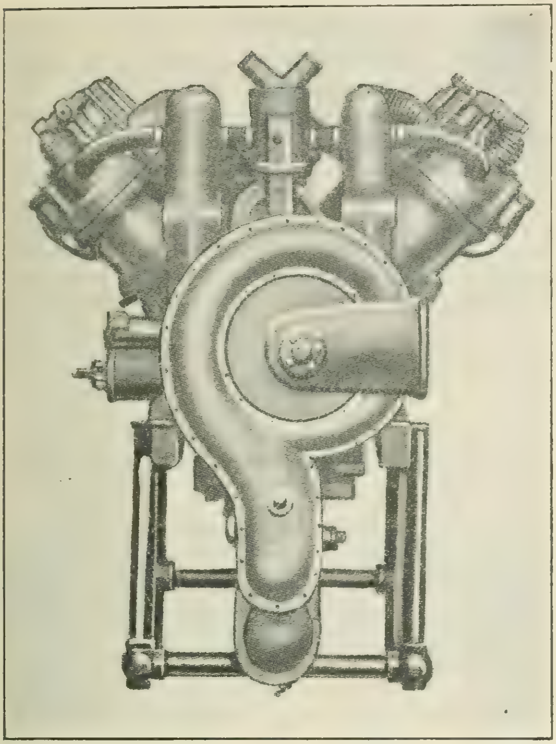
When it comes to practical and continuous flight it is necessary for many reasons to be able to operate at considerable altitudes, and at once difficulties are encountered. The rarified atmosphere affects not only the pilot but also the motor, so that at approximately 20,000 feet the engine develops, other things being unchanged, but 50 per cent. of its sea level horsepower. At the same time, to compensate for the lack of support afforded by the varified atmosphere the speed of the airplane must be increased materially, and this increased speed cannot be obtained on account of the lowered power of the engine.

This matter has been written up very completely in a recent issue of the *Scientific American* by Mr. Benjamin S. Foss, and from that article the following is abstracted:

For a long time it has been recognized that, if the air density at the intake of the engine were held constant, the horse-power of the engine would be maintained. The physical properties of the atmosphere remain the same at all altitudes, it being merely a question of increasing the density to approximately sea-level conditions, to maintain the sea-level power of the engine. This is a question of forced draft.

The difficulty of applying forced draft, as it were, to the engine has been to develop a device sufficiently large to furnish the volume of air necessary, capable of producing the required air pressure and at the same time, light enough to be used on an airplane. Moreover, the means of operating this device has been a controlling factor, inasmuch as variable speed is desirable to vary the air pressure and volume according to changes in altitudes and atmospheric density.

At the recent Aero Exposition in Madison Square Garden, a prominent American manufacturer exhibited a rotary blower, mounted on a well-known type of airplane engine. This blower is the result of two years' development and test on the part of the company's engineers, and now for the first time was publicly shown. The device, which is called a "super-charge" fan, consists of a high speed rotary blower, mounted on the engine bed and driven by the engine, through



AIRPLANE ENGINE CHARGER.

a variable speed mechanism. The blower consists of a fan wheel, cut out of a solid billet of steel and enclosed in a spiral aluminum housing. The fan is mounted on ball bearings and driven through a chain of gears with final belt connection to the engine. It operates at 10 times engine speed, approximately 15,000 revolutions per minute. It is stated that the fan will deliver a pressure as high as 14 pounds per square inch, which performance is certainly unusual in a single stage fan of this description.

The blower is entirely automatic in operation and is controlled by a barometric device connected with the variable speed drive, whereby the air pressure is increased proportionately to the air density. The blower comes into operation at a low altitude, and gains speed gradually, until it is operating under full load conditions, at approximately 20,000 feet altitude. The power of the engine, which would be lost through change in atmospheric density, is thereby recovered.

It is interesting to compare the results achieved with this device as against the results without it. The engineers supply the following significant figures:

The engine shown in the illustration weighs 480 pounds, and is rated at 210 horse-power at sea-level. At 20,000 feet altitude, this engine normally develops about 100 horse-power. The engine with the super-charge blower weighs 530 pounds and develops 210 horse-power at sea-level. At 20,000 feet altitude, however, the horse-power remains the same, namely, 210.

The Liberty engine develops approximately 400 horse-power at sea-level and weighs 860 pounds. At 20,000 feet, the horse-power developed is less than 200. With the super-charge blower, the weight becomes 910 pounds, and the horse-power at 20,000 feet is maintained at 400.

The superiority of the first engine over the second at 20,000 feet is remarkable and should be noted. The smaller engine develops only one-half the power of the larger at sea-level, but, equipped with the super-charge fan, it develops slightly more power at 20,000 feet. Moreover, the difference in weight is 330 pounds, in favor of the smaller engine. At this altitude the weight per horse-power is 2.5 pounds for the smaller engine and 4.3 pounds for the Liberty engine.

The development of a successful super-charge blower opens up enormous possibilities in the aircraft field, and it would seem that the future holds much in store for the successful application of such a device to all military and high speed airplanes, designed to operate at high altitudes. The theoretical possibilities of high speed at high altitudes are almost unlimited. In fact, the human element is the only factor that would seem to constrain progress in this direction. It is probable that the development of the super-charge idea will be applied to the human occupants of the plane as well as to the engine, and imagination pictures airplanes of the future proceeding through the upper strata of the atmosphere, 30,000 to 40,000 feet above the earth, at speeds of from 300 to 500 miles per hour.

AUTOMATIC HIGH SPEED TURBO BLOWER

We here illustrate an interesting turbo blower unit recently installed by the Rateau-Battu-Smoot Company, New York, for the International Nickel Company at Port Colborne, Ontario, Canada, W. O. Wotherspoon, Consulting Engineer, 43 Exchange Place, New York.

Fig. 1 shows the complete apparatus as installed, and Fig. 2 shows the same with the upper portions of the casings removed. The machine has a capacity of 15,000 cu. ft. of free air per min., delivered at 15 lb. gage pressure. The

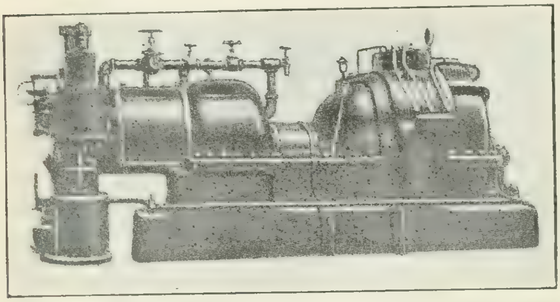


FIG. 1—COMPLETE APPARATUS INSTALLED.

speed of rotation is believed to be the highest ever employed for a machine of this capacity and type.

The driving end of the machine, at the left in the illustrations, consists of a three-stage steam turbine in which the wheels are forged integral with the shaft. The turbine develops a maximum of 700 h.p. with steam at 150 lb. gage, 100 deg. F. superheat and 1 lb. abs. exhaust. The turbine and the blower shafts are connected by a flexible-pin type coupling.

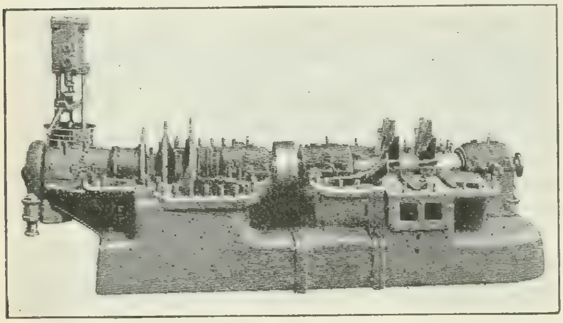


FIG. 2—APPARATUS WITH UPPER PORTIONS OF CASINGS REMOVED.

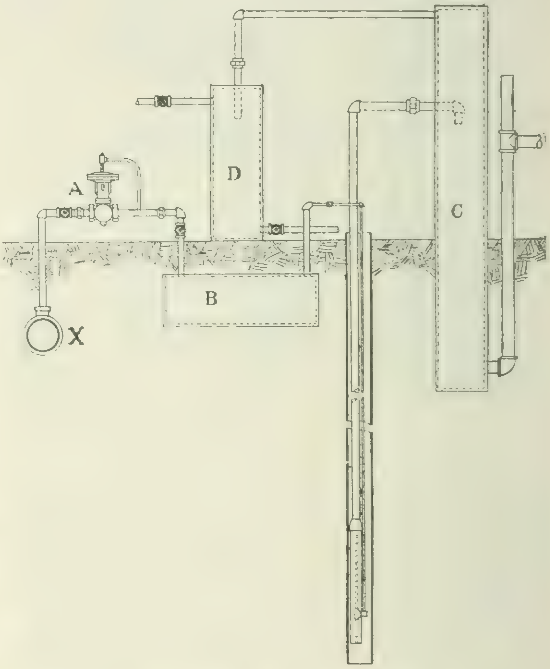
There is a sensitive, constant pressure regulator, and, as the air delivered is for use in copper converters, a stabilizer has been added to permit the blower to run without surging at all loads.

A safety device to prevent over-speeding is also provided. This consists of a small fan on the outer end of the turbine shaft which maintains a definite pressure on a tripping device controlling a butterfly valve in the steam line.

The proposed tunnel for connecting Denmark and Sweden will start on the eastern side of the Amagar Island. Construction, however, will be commenced by sinking shafts on the island of Saltholm. The tunnel, which will be in limestone throughout, will be 11 miles long, while the total length of the railway will be 31½ miles.

PRESSURE OF NATURAL GAS OPERATES AIR LIFT

There have been such enormous and constant wastes in connection with the production, distribution and use of natural gas that an example of real economy in the service is deserving of special notice. In the neat and ingenious arrangement here presented the pressure of natural gas is employed for the lifting of water precisely as air is used in the air lift, and when the gas has done this work it is returned to pipes for legitimate use and none of it is wasted.



NATURAL GAS AIR LIFT.

The description and illustration has been prepared by Mr. G. E. Howard, Master Mechanic, Ohio Fuel Supply Company, Columbus, Ohio, the publication being by permission of the Natural Gas Association of America.

Gas from a high pressure line is passed through the small regulator "A" to reduce it to the pressure at which the wells will flow the greatest volume without blowing through. From the regulator it goes into the surge tank "B" to neutralize pulsations. Passing out of this tank it flows the wells in the manner of an ordinary air lift.

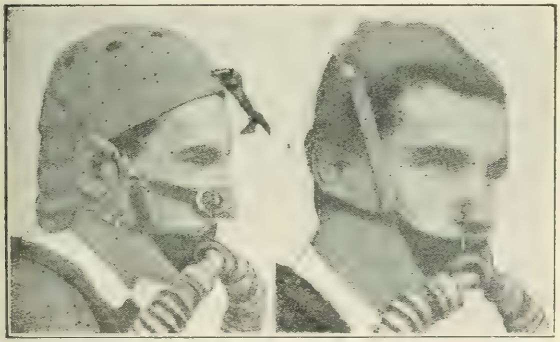
In order to recover the gas, the mixture of gas and water is discharged into the trap tank "C." From here the water flows out through the riser pipe opening out of the bottom of the tank. The tee in this pipe should be at sufficient height to prevent internal pressure from forcing the water level down to the outlet, and allowing the gas to escape. This vertical distance will be determined by the pressure to be carried in the fuel line. A vent should be left in the highest point of the riser to prevent siphoning.

From the trap tank, the gas passes out at the top and into the drip tank "D," from where it goes directly into the fuel line. Whatever amount of water is carried over from tank "C" will collect and can be blown off through the drip in the bottom of tank "D."

The tanks can be conveniently made by welding heads into pieces of 18" pipe.

NOSE-CLIPS FOR RESCUE APPARATUS

A memorandum on "Nose-Clips for Rescue Apparatus" has been prepared by Dr. Henry Briggs in connection with the work of the Mine Rescue Apparatus Research Committee, which is carrying on investigations under the (British) Department of Scientific and Industrial Research.



HOW NOSE CLIP IS APPLIED—THE LEFT HAND PICTURE SHOWS THE SCREW-CLIP, THE RIGHT HAND VIEW SHOWS CLIP USED AT SWANSEA RESERVE STATION.

As was instanced by the death of a rescue man at the Podmore Hall Colliery in January, 1918, a gassed and struggling man may not only displace his own nose-clip, but may also make his rescue difficult by knocking off those of his companions when they come within reach. Similar cases occurred in operations with Proto apparatus at the front. The problem of obtaining a clip which securely closes the nostrils while being difficult to displace, has been considered by the Committee, and, in view of the importance of the matter, they deem it advisable to publish a description without delay.

Fig. 1 illustrates a screw-clip, designed by Dr. Briggs, which is safe and comfortable. Dr. Tissot's method of fastening the clip to the skull-cap has been adopted. The skull-cap is that of the Proto apparatus, to which ear-rings have been sewn. The mouthpiece and nose-clip are held on by adjustable bands, each of which ends in the spring-hook of a watch chain. The wearer soon becomes familiar with the loop on the ear-ring to which each spring-hook attaches, and the arrangement expedites the operation of "harnessing up."

The bridge bar of the nose-clip passes under, instead of over, the nose, and the tension of the bands passing across the cheeks is taken by a narrow linen strip crossing the nose. The broad soft oval pads closing the nostrils, and the screws which adjust them, resemble those of the clip which is in regular use at the Wath station.

The form illustrated cannot drop off when the wearer's nose becomse slippery with perspiration; and, as no part projects above the nose, it is unlikely to be disturbed by an accidental blow. It has been tried at the front with satisfactory results, and at the Edinburgh station, where it is liked by the trained men. The Committee has decided to have a number of these head dresses made, and to distribute them as samples among rescue stations and makers of rescue apparatus.

Fig. 2 shows a clip which has given satisfaction at the Swansea rescue station, and which possesses considerable security against accidental displacement. Though not so comfortable as the first variety, it may be preferred by those accustomed to the spring clips. It will be observed that the wire from which the clip is formed is caused loosely to encircle the metal portions of the mouthpiece. A piece of elastic draws the legs of the clip together. The German screw-clip is similar in type, but heavier, and less secure.

AUTOMATIC CONTROL OF MOTOR-DRIVEN COMPRESSORS

We present here one of the latest practical solutions of the always interesting problem of providing apparatus for the automatic control of motor driven air compressors. The device originates with the British Thomson-Houston Company, Limited, of Rugby, and for the illustrations, and description we are indebted to *The Engineer,* London.

The apparatus is intended (*a*) to unload the compressor before starting and until full speed of the motor is reached, and on stopping; (*b*) to stop the motor when the consumption of air

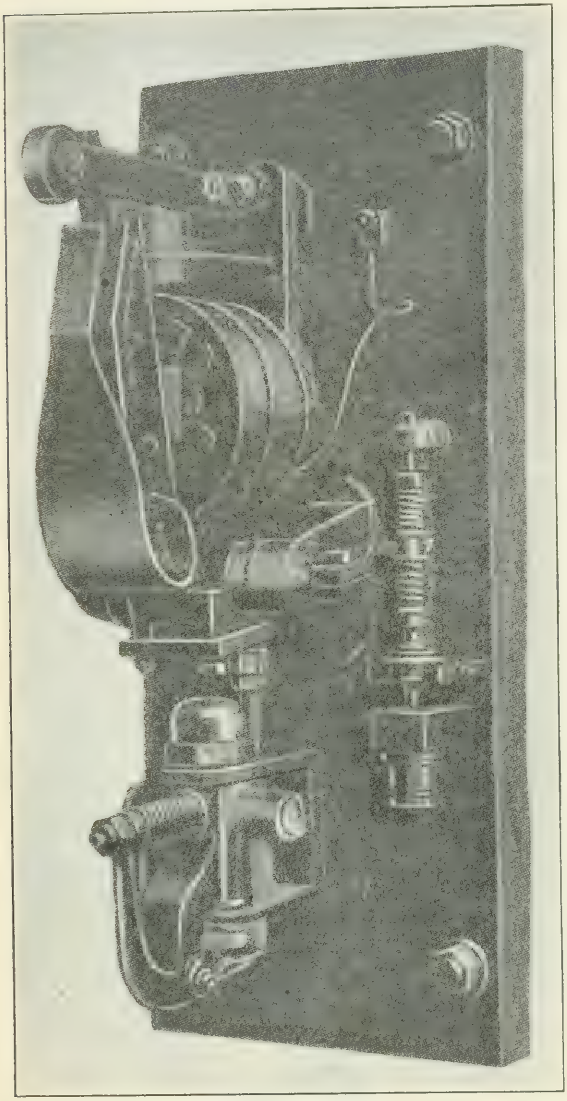


FIG. 1—AUTOMATIC VALVE FOR AIR COMPRESSORS.

is small relatively to the capacity of the compressor, and when the pressure in the receiver rises to a certain predetermined maximum; (*c*) to start it again when the pressure has fallen to a predetermined limit; and (*d*) to make it possible, when the consumption of air approximates to the full capacity of the compressor, to run the motor continuously, the compressor being loaded and unloaded at minimum and maximum pressure respectively. In whichever manner it is determined to operate the compressor—either intermittently or continuously—no further attention is, we gather, required after the closing of the main switch, the subsequent operations being entirely automatic.

The essential parts of the apparatus are as follows: (1) Pressure governor; (2) contactor starting gear; (3) magnetic pilot valve; (4) time lag device; and (5) lever switch. A main unloading valve and a non-return or check valve are also required, placed on the delivery side of the compressor.

The magnetic air valve is a combination of an electro-magnet of the contactor type, a two-way valve, and a small switch controlled by a dashpot—see Fig. 1. These parts are not of the nature of untried apparatus, but are such as have been commonly used on British Thomson-Houston contactor panels or in steam locomotive practice, and have demonstrated their reliability in actual use for years. They are supported on a slate base with corner feet for bolting to a vertical surface. In the drawing—Fig. 2—the compressor is represented as being at rest with the receiver fully charged. The valve V_1 being open, admits air from the receiver to the unloading valve, thereby opening the compressor cylinder to atmosphere. When the demand for air is such that the pressure in the receiver falls to a predetermined minimum the pressure governor switch A closes, and by doing so energises and closes the auxiliary contactor B and the interlock C attached to it. Current then passes by way of interlock C to the main coil D of the automatic starting gear and starts the motor. The starting contactors are not shown in the diagram for the sake of clearness. Each contactor operates under current limit control, *i. e.,* the second contactor cannot close until the starting current, which had risen when the first contactor closed, has fallen to a predetermined figure, and so on during the complete operation of starting.

As yet the pilot valve solenoid F is not energised, its circuit being interrupted by the interlock E, which is attached to the last main contactor. The valve V_1 of the pilot valve therefore remains open and air passes from the receiver to the unloading valve. At the moment when the last contactor closes and cuts out the last section of the resistance the motor having then attained full speed, the interlock E closes, and current then passes the pilot valve solenoid F, which closes, thereby forcing down the rod G, closing the upper valve V_1, and cutting off the supply of air from the receiver. At the same time the valve V_2 opens and the air contained in the unloading valve is free to pass through the pipe H, the lower valve V_2, and out at the opening J. The unloading valve then closes and loads up the compressor. It will be realized that the load is not applied until the motor is up to speed. The closing of the pilot valve solenoid F also closes the interlock K, which is in parallel with the interlock C.

When the demand for air decreases and the pressure in the receiver rises to the predetermined maximum the pressure governor switch A opens, thus opening the auxiliary contactor B and the interlock C. The pilot valve solenoid F is then de-energised, the rod G is forced upwards by means of the spring Q, the lower valve V_2 closes, and the upper valve V_1 opens. Air from the receiver then passes once more through the valve V_1 to the unloading valve, which opens, and in doing so unloads the compressor. During this period the main contactors are not affected, since they are kept closed by the interlock K, the movement of which is delayed by the dashpot M. After a predetermined period of time has expired this interlock opens, trips the main contactors, and stops the motor. It will be noted that the motor is not stopped until the compressor has been unloaded.

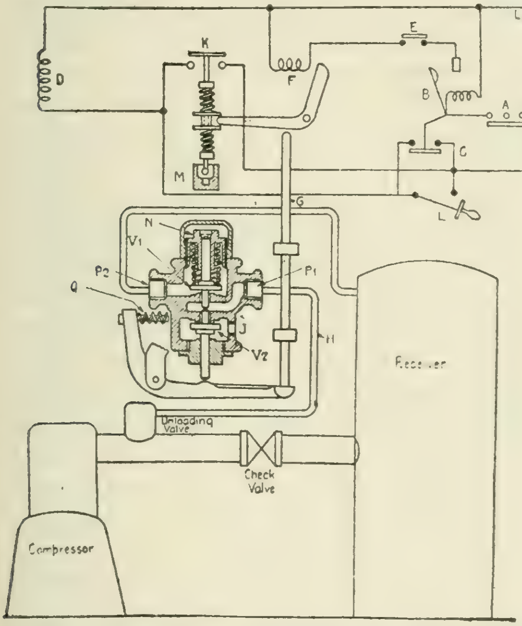
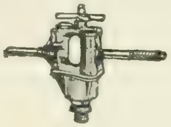


FIG. 2—SHOWING WORKING OF AIR VALVE.

By closing the lever switch L the compressor will run continuously, the pressure governor A then having no effect on the main contactors D, but only on the unloading valve through the operation of the pilot valve. The compressor is, under such conditions, loaded or unloaded at the minimum and maximum pressures respectively.

When large multi-stage compressors, which involve the use of intercoolers and much piping, are used, the continuous loading and unloading of the compressor means a considerable loss of compressed air. In such cases it is recommended that two air valves be employed instead of one, the first air valve operating on the air intake side of the compressor and the second one on the delivery side. As an interval of time elapses between the operation of the two air valves, *i. e.,* between the closing of the intake and the opening of the delivery, the compressed air contained in the system is allowed to be forced through to the receiver before unloading takes place, so that when the delivery side is opened to atmosphere it is practically at atmospheric pressure.

The claims made for the apparatus are summed up by the British Thomson-Houston Company as follows: (1) The control is entirely automatic; (2) the motor starts unloaded, so that current and time are saved; (3) the starting current cannot exceed a certain predetermined limit; (4) the compressor is unloaded before stopping, thus avoiding sudden stresses; (5) power is saved, as the compressor runs only when air is required; (6) if preferred, the compressor can run continuously, automatically loading and unloading as required; (7) wastage of air with large multi-stage compressors is avoided; (8) decreased wear and tear of the compressor, due to the absence of severe stresses when starting and stopping. The air valves described in the foregoing are made for pressures up to 300 lb. per square inch, an adjustable spring being provided for adjusting to the pressure required. They are made in two types for alternating and direct-current circuits respectively and to suit voltages up to 550. They are supplied either as separate units or may be combined with a pressure governor on the same base.



The cheap production, by American chemists of helium, the non-inflammable gas, is one of the most notable developments of the War. If Germany could have filled her Zeppelins with it there would have been a different story to tell of their accomplishments in the War. When we entered the War the Allies told us that there was a crying need for a balloon gas that would not burn, and they suggested that our chemists pay some attention to helium. The efficiency and success of the attention given is shown by the fact that the cost of production was brought down from $1500 to 10 cents per cubic foot, and even this figure may be lowered.

COMPRESSED AIR MAGAZINE

Established in 1896
COMPRESSED AIR MAGAZINE CO., PUBLISHERS, EASTON, PA.
Devoted to all useful applications of compressed air and to everything pneumatic
NEW YORK: Editorial and Business Offices, Bowling Green Building, No. 11, Broadway.
Telephone: Bowling Green, 8430; Cable Address: "Compaire" N. Y., Western Union Code.
LONDON OFFICE: No. 165, Queen Victoria Street

VOL. XXIV, NO. VII. *JULY, 1919.*

W. L. SAUNDERS, *Editor*
FRANK RICHARDS, *Technical Editor* FRANCIS JUDSON TIETSORT, *Managing Editor*
CHARLES A. HIRSCHBERG, *Business Manager*

Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

Subscription rates—Postage Included
The United States, American posessions and Mexico.................$1.00 the year
Dominion of Canada and other foreign countries.................1.50 the year
Single copies—Ten cents
NOTE—Subscribers will please notify the Circulation Department at once of change of address or in case of belated delivery or non-delivery.

PUBLISHERS' ANNOUNCEMENT

WITH THE completion of the present volume of COMPRESSED AIR MAGAZINE (in December, 1919), the publication will have an entirely new typographical dress. It further will be modernized by increasing the size of its pages to the lately adopted standard of the trade press, 9x12 inches. This will make the advertising measurements uniform with those of many other contemporary technical and trade periodicals, so that advertising plates may readily be interchanged to the obvious advantage and convenience of advertisers. It will also permit greater freedom in the illustration of text matter, and betterments generally that are not possible with the present size of page. The change in size cannot be made sooner as it would conflict with the binding of volumes of the 1919 issues.

Although it is anticipated that improvements constantly will be apparent throughout the remainder of the calendar year, in keeping with lately developed plans of the publishers, they will depend for fullest expression upon the change in size to be effective as of January, 1920.

Beginning with the latter date, we also desire to announce, the subscription price for the magazine will be advanced to a point more nearly commensurate with its value as the world's only periodical devoted to the useful commercial applications of compressed air and pneumatic practice. The domestic subscription rate will become three dollars and the foreign rate three dollars and fifty cents per year, the price per copy becoming twenty-five cents. No renewals of subscriptions are to be accepted after December 1, 1919, at the old rates, and renewals meantime cannot be taken for a period of more than two years.

The material improvements in text and illustrations for the benefit of readers will make it requisite that advertising rates shall also be increased somewhat. We have carefully deliberated this point and consulted some of our advertising patrons. These have agreed that the increase might reasonably be made to afford advertisers the benefit of the kind of service they would logically expect and demand under the more ambitious publication arrangements contemplated.

A revised rate card is therefore to be issued and distributed on October 1, effective as of January 1. After the latter date renewal contracts or new business will be subject to the new rates without discount, as the prices will be net and flat. Between the present time and January 1 new advertising contracts will be accepted at the present card rates, but without discounts formerly allowed.

Rates for space in this magazine on the present actual circulation basis of 15,850 copies; have been much too low for service and value given. They have not been commensurate with the production costs of the publication, which, in only a few years of its quarter century of existence, has ever paid a dividend. When there have been dividends they have always been devoted to the betterment of the magazine.

This journal has not been conducted in the past, and will not be conducted in the future, in the spirit of a commercial enterprise. The mission of COMPRESSED AIR MAGAZINE is wholly that of an informative messenger on the developments in the growing field of compressed air application and kindred subjects. Its spirit is professional, rather than that of the counting room, as we feel sure its old-time readers will be glad to attest. We have, perhaps, been a little old-fashioned and conservative in this regard, but the directors of the magazine's policy do not feel impelled to change it, even under the altered plans of publication, which are in response only to requirements of convenience, utility and good taste.

We are pleased to note a modest but constant gain in our circulation, and also in our advertising, neither of which are the result of having been solicited. It may be of interest to the reader to know that this is one of the most unusual technical publications in the world in that it has very rarely, if ever, solicited advertisements. We have no advertising manager.

For the benefit of our readers, however, who are interested in, and in the market for, all manner of pneumatic and compressed air devices and machinery, we contemplate inviting, by mail at least, other manufacturers, not already represented in our columns, to engage space in these pages for the year 1920. We earnestly believe this will be for their own best interests and the advancement of the entire air compressor, pneumatic tool and allied industries. All should be represented, we feel, in the only publication of either America or Europe that covers this particular field.

The editors wish to take advantage of this occasion, for we very seldom mention the affairs of the magazine in its columns, to thank the many friends of the magazine at home and abroad for their kindly coöperation in offering helpful ideas and suggestions, most of which have been privately offered. We are of opinion that many of such letters might better be published hereafter to the advantage of engineers, producers and other technologists in the compressed air field. We shall therefore welcome, henceforth, all such utterances, for publication.

PROF. PARSONS DILATES ON "ART" IN TECHNICAL ADVERTISING

AT THE LAST monthly meeting and dinner in New York of the Technical Publicity Association, before the summer recess, the 150 members and guests present enjoyed an unconventional discourse by Mr. FRANK ALVAH PARSONS of the New York School of Fine and Applied Arts on the subject of "Art" in Advertising. We timorously put the word *Art* in quotation marks as a direct result of having been hearers of the sentiments propounded by Professor PARSONS in his helpful and witty address.

COMPRESSED AIR MAGAZINE wishes that every one of its advertisers and every other manufacturer and machinery man might have heard every word Professor PARSONS had to say. He made a distinctly valuable contribution to current advertising literature. We should be vain to attempt to convey his message to our readers or to interpret it, for to do it justice Professor PARSONS' personality would have to go along with it—that is, for one to obtain the entire effect of his words. His opposition to prevalent ideas on art and what that terminology means in its catholic sense, may be profitably considered, however, by every machinery advertiser or manufacturer.

To use the word *art* or *artist* as they are carelessly flipped about in daily use is to flaunt the red bandanna in the face of this baited one of Upper Broadway. After one recognized publicity expert had been heard by the diners, on the occasion to which we have referred, Professor PARSONS challenged with the declaration, "there hasn't been a word said tonight that touched *art* in any way." And that was the subject assigned to the speakers of the evening!

Art was what required to be straightened out in our minds. There are many misconceptions about it, not alone in the advertising field, although that contains "many of the most ignorant persons in the world," (joyful laughter) but among architects, painters, interior decorators and other persons—believe Mr. PARSONS after twenty-five years of experience. It is not strange that there should be misconceptions about it among advertising men, because advertising is among the newest of the world's arts, which exists as an expression of something that really was demanded by public conditions, by social, economic conditions. The world had gotten so big, nations had become so commingled and people were so multiplied, that the individual human being could not get to every person to whom he wished to sell his product. Advertising came about when people couldn't reach their human objective first hand, face to face.

Professor PARSONS declares "when an individual has any idea to sell—I don't care what it is —it requires art. It requires art for a clergyman to get a call to come even to a Presbyterian church. He has to sell himself to his prospective congregation before he comes. It is just the same proposition if I want to sell a machine, or curtains, or underwear, or anything else—plus the peculiar conditions of people to whom the message is to be taken."

Advertising has grown with tremendous rapidity since it first developed, and nowhere, probably, has it developed to such an extent as in the United States. Art in its application to advertising, as in other things, is nothing more nor less than expressing a thing in its clearest, most utilitarian way, "in a manner that will not make you ill."

That is all it took to build the greatest cathedral that ever was, the best of Greek temples, the worst of all New York churches, the greatest of all plays, the greatest music, the greatest literature. Advertising art is all one thing with these other things—it is an attempt to express in a utilitarian way, so there shall be a perfect fitness to purpose, any message, any idea, or anything externalized in any material whatsoever, in decent taste.

Our mentor assures us that we may put a pump on a page decently, that we may arrange the cut of a machine with whatever "copy" we have, so anybody can read it and read it easily, can understand what we want to say, and that the materials for the advertisement can be assembled in such a way or in such a relation so that it is in good taste. (Reasonable enough, Professor, but not so easy as it sounds).

What art is *not* strangely interested us. In the first place how dare we call people who bring around drawings to us, "artists?" (Gusts of merriment). By what right, he would like to know, do we submit to the tommyrot that we have submitted to in the name of art? Think we that every man that draws a picture is an artist? Most of them are damphools, that's what they are, and the men who take their things are more so! It isn't necessary to have a picture to have art, anyway. If there weren't any pictures, there might be a chance, maybe, for art. As long as there are so many there is no chance. An artist is not one who can draw a picture—not necessarily one even who can draw right well.

In the first place a picture, whether for advertising or any other purpose, that doesn't express an idea so that any person of common sense can get the message and the idea clearly and easily, is not the work of an artist. The artist does just that—first—and he is doing it artistically if he does it with a certain charm and feeling. There seems to be an impression that when a thing is "dolled up" enough it is art, but let us not be deceived. All that is fussed and feathered and frivoled is not artistic.

As a general proposition, prettiness is not art, age or antiquity is not art and authenticity is not art. A well known man's name does not guarantee an artistic quality for his work. If the so real peaches on the diningroom wall make your mouth water, that is not art, because art is not appetite. Art is not nature, because it is the absence of it. Nature is the work of the Creator, who attended well to it. It's not a man's business to try to imitate it, but to *adapt* it.

It was plain to be seen that we had great faith in certain people, who have drawn things, because they have a name. A thing doesn't have to be done by LEYENDECKER to be good; it needn't even have been born in Boston, where Professor PARSONS came from. In fact it isn't essential that any locality, or any price or any person should make a thing good.

Professor PARSONS observed with a good deal of iconoclastic feeling that it is perfectly damnable what the president of a trust can put in his house as he gets richer and richer and just as astounding what the president's wife can wear the more her husband looses the family purse string. "Is that *art,* for heaven's sake, just because she can buy it?" Not much. If she knew what to put on, considering who she is, and what she looks like, and where to wear things that she puts on, considering whom she will see, she *would* be an artist.

The price of clothing, as of a drawing for an advertisement or of anything else, we were made aware, hadn't a single thing in the world to do with the quality of art whatsoever.

REMBRANDT did some very bad things in his day. Great people do not produce good things all the time—nobdy ever has and nobody ever will. The greatest artist in the world is likely to be out of his best gait part of the time.

As regards the authenticity of works of *art,* Professor PARSONS has seen folk all over Europe peering at things with a microscope to see whether they are authentic. But even if the greatest critics in the world say that a thing is antiquatedly authentic it doesn't make a particle of difference—it doesn't add to its art quality. Yet with some folk if it is authentic no price is too high to be paid for the thing under consideration.

With respect to technical and other advertising we were quite emphatically informed that properly chosen colors, paper and type should be used to convey an idea. It is a pity if the quality of paper says one thing and the type another, or if the picture used should neutralize the idea.

Art, Mr. Machinery Man, is a state of mind, be sure of that. How can one see art when he is praying to see oranges because he happens to like the taste of them? How shall one ever know what art is if one thinks that fussing up a thing is art? Did one marry a Christmas tree when he married a wife, or did he marry a woman? Does one wish to see his better ¾ draped in all manner of things that do not belong on her—in a setting of a junk shop of a house called a home?

How can one go into the St. Regisbilt corridor, turn to the right, go into the reception room and come out moral? We are guilty of an insane desire in America to show off. There isn't a place on earth where size, amount, swiftness and display continue as the qualities that will get a man or woman into heaven, as they do in this country. The highest building, the greatest subway, the largest hotel, the most garish theatre, the richest man, the tawdriest woman, all exist—and we are proud of them, now aren't we?

When a thing reaches the stage of ostentation it isn't art. When a thing becomes overfed it is time to cover it up.

Art always comes as the answer to a particular need. The need for it is tremendous in advertising, because it is the bread and butter, the life of men who are using it, especially of the manufacturing men who are using it. We must know how to express the good things about a machine we would sell; we must express the answer to a need in its best terms. That is art in advertising, its language being that of color, line, form and texture, and no more. Used properly they will carry a message with the clearness and force that we need.

It makes a difference whether we use black or white, or blue or gray. We can undoubtedly advertise machinery better with black and white, but the first question is whether the shape and size on the page are correct so they will convey the right message. Color and form and line must control the arrangement of an advertisement, if the reader is to grasp the idea to be conveyed. Professor PARSONS himself has to be held in a chair while he reads most advertisements, he admits, so there must be a lot of room for improvements in the general field.

Another thing that *art* is—it is choice, the selective faculty. It is the ability to select the right thing to tell the story. One may be an artist and yet not able to make a single drawing. If we can lay out a page so anybody can read it when it is finished, then we are artists.

The technical publicity fraternity will be grateful to Professor PARSONS for his clear exposition of principles, which were clearly recognized because of the way in which they were expressed—and that too was art!

HELPING INDUSTRIAL EUROPE GET ON ITS FEET

QUITE THE most interesting, not to say informative description of European economic conditions, though comprising a dark picture, was brought back to the United States by Mr. FRANK A. VANDERLIP recently and given to members of the Economic Club, the Civic Forum, the Mid-European Association, Merchants' Association of New York and other bodies. Most manufacturers and industrial financiers have had considerable confidence in Mr. VANDERLIP as an observer, due to his training of earlier days as a newspaperman, his experience as a government official and his career in banking to a point where for ten years he was the titular head of one of the largest aggregations of business capital in the world. He resigned as president of the National City Bank on June 3.

In a nutshell Mr. VANDERLIP discovered that continental Europe was paralyzed industrially and socially and he made the correlative finding that it was the task of the United States to relieve Europe, in self defense. The continent is in a starving condition over large areas. Furthermore food conditions, due to lack of planting at home through loss of farm animals, and due to lack of transportation facilities for food imported, are unlikely to become greatly bettered for some time to come.

Britain, he thinks we should know, was threatened by revolution, though English common sense triumphed, and he found that ogre, Bolshevism, rife in Spain, though that has been the most favored and prosperous of European countries as the result of the war. Barcelona is a hotbed of radicalism with a reign of terror caused by unpunished assassinations directed by a mysterious, secret body. The suffering in Europe for some time to come will equal, if not exceed that of actual war times.

Mr. VANDERLIP found that the best of printing presses were installed at Petrograd and were turning out unlimited quantities of counterfeit pounds, francs, marks, lira and pesetas, so skillfully made as almost to baffle detection. He declared that these false issues of money were being expended largely by Germans to foment Bolshevist propaganda.

American manufacturers began to prepare six months ago for a commercial campaign in Europe. Scores of executives and expert salesmen were dispatched to Europe; there was much hopefulness and much talk that big business would result. The market exists for goods, for machinery, for foods; there is a great yawning maw of a market, an omnivorous demand, but—the means for doing business are lacking. The industrial and financial chain is broken. Payments for goods depend upon home production, naturally, and there is no production. To pay, one must create or produce something to pay with. It cannot be done with worthless pieces of paper.

The deductions to be made from the banker's discoveries over a period of four months in seven countries are that America alone can save Europe, and that its aid must be extended impartially and equally to all of the stricken countries.

There is an "awful scar across Europe from the German border to Zeebrugge." No words can tell of the destruction wrought by minds that planned economic obliteration, but this destruction is not the greatest cancer wrought by war. It is the idleness that has been laid upon the countries by the mailed hand of war. To quote Mr. VANDERLIP:

> Now, why should a factory unharmed by the war, in the midst of a continent wanting everything, incidentally be idle? Why should there be 1,000,000 people in England receiving an unemployment weekly dole? Why should there be in little Belgium 800,000 people receiving a weekly unemployment wage? Now, let me try to give you a picture of the difficulties that a manufacturer is under in Europe today in an attempt to start his factory.

In the first place his labor has been dissipated and he faces the very difficult labor situation, although he is surrounded by idleness. The war has had a bad effect upon the morale of people. That is particularly noticeable in Belgium, where for the four and one-half years there has been partial idleness of people supported from the public purse, and the serious effect upon the character for the moment, at least, upon those people.

But our European manufacturer must have raw material. Probably it must come from out of the country. He must have the exchange to pay for it. He must have credit, very likely. Now, I have come to see these nations from a new point of view, from a point of view of what they must have from outside to sustain life and go on in a more normal course, and what they have got to pay for it with.

Let me picture a pair of balances, into one scale of which you will put all the things that a nation must have. In Italy coal and cotton. In France cotton and wool, most of the metals. Let us put in the other balance everything a nation has got to export. Well, obviously, at the moment, these nations, wanting everything, industrially disorganized, and nothing to send out—our scales are out of balance.

Now, what can be done? We cannot take anything out here, because presumably we have reduced these imports as low as they can go and have the nation live; put more in here, but you cannot put more if your industries are paralyzed. What other way is there to balance this, and it has got to be balanced? It must be balanced, else things cannot be had that are essential to the nation's life.

Well, normally we would put gold in there, but of course now there is no gold that these countries can spare. What else can we put in? Credit, that is one thing. There are just three things that will go into this balance to balance these necessary things that the nation must have—goods, gold, credit—and so right on the threshold a manufacturer needs a foreign credit. He must have a foreign credit if his raw material is to come from abroad.

Now, what are some of the other things that are difficult? He is facing a wage situation two or three times what the wages were in pre-war days. He is in a currency situation that is chaotic. Some of these nations have a variety of currency at the present time that is almost laughable except that it is horribly serious.

Mr. Hoover is authority for the statement that the railway breakdown in Central Europe and east of Germany is so serious that there is bound to be starvation. To an American the expression "starving people" is oratorical; it is a long way off, we do not get it, we do not understand it.

Aside from the effect on food, the transportation problem affects the manufacturer in getting his raw material. It prevents him shipping his finished products. But what about his market for the finished products? There is the rub. The markets of Europe are ravenous for things, and they have got nothing with which to pay.

The manufacturer, starting with a disorganized labor situation, a wage scale three times the pre-war scale, a demoralized morale, great difficulty in getting foreign exchange to pay for his raw material, great difficulty in getting bottoms to ship it, great difficulty in getting it transported to him after it arrives at the port, must still produce. But after he produces he has not the market that can pay, a market that will give him the means to go on completing the industrial cycles of buying more raw material—paying his labor.

Europe has increased its population since the Napoleonic wars from 175,000,000 to 440,000,000. Think of those figures—175,000,000 to 440,000,000! Now Europe did not become any more productive. She probably does not raise a very great amount more food than she did a hundred years ago.

Mr. Vanderlip's conclusion, in the face of the significant picture he has drawn, are that the whole European machine is so completely disorganized that it wont run unless we help it. We must furnish the fuel and lubricants and some intelligent and courageous engineers. Giving Europe charity will not save it—we must give charity of mind, not money. But we must get some priming into the business pump to get it started.

First of all, we must be sympathetic and then there must be a comprehensive attempt on the part of our bankers, our manufacturers to restart the European industries. We can and must help Europe to get a start toward a normal life again. It is the greatest opportunity that ever came to a people.

We can feed the world, finance the world, and provide it with raw material. Other nations have in the past been financial reservoirs, but they have not been reservoirs of raw materials as we are now. We must be careful, we must be considerate and we must be generous, or our favored position will avail us little.

Sir JOSEPH DAVIES, M. P., who has been visiting America, declared in an interview that he considered Mr. VANDERLIP had made a remarkably able analysis of conditions in continental Europe. In England, however, he said there was no "paralysis of industry." Three million of the four million men discharged from the army had already been absorbed by peace-time industries. Even half of the 500,000 women who lost their war jobs had been placed in peace time occupations. Britain suffered deeply from the war in loss of man power and wealth, but her case is hopeful, Sir Joseph declares.

"Our mines, our food production, our other industries have been so developed during the war that we are working as never before," he said. "Why, take the matter of dyes and chemicals. Before the war we imported these products mainly from Germany. Now we have developed the industry so within our own shores that before long England will be exporting chemicals and dyes.

"The British capacity for the manufacture of textiles is bigger now than at any other time. There are places for our workers in the coal mines, the iron and steel works, the shipbuilding, railway locomotive, carriage building and especially in the motor industries.

"Of course certain industries have been affected by the blockade of the European markets. This, in fact, is one of the few things that is preventing a complete return to normal conditions, and once peace has been brought about this obstacle will be removed."

EDITORIAL NOTICE

IN LINE with the new policy of the Publishers, looking towards an improvement in the service of the COMPRESSED AIR MAGAZINE to its readers, the management wishes to take this occasion to announce the appointment of Mr. FRANCIS JUDSON TIETSORT, as Managing Editor.

Mr. TIETSORT is a writer of considerable repute, having been engaged in newspaper and magazine work for the greater part of the last twenty years. His editorial connection with daily newspapers have included the *San Francisco Chronicle, Denver Evening Times, New York Herald, New York Times, New York Evening Post* and the *Philadelphia Public Ledger*. He was formerly associate editor of the *National Marine Magazine* of New York, and was the founder and editor of *Revista de Automoveis* (Automobile Review) published in Portuguese at Rio de Janeiro, Brazil, where Mr. TIETSORT remained nearly four years. He has been the author of many articles and treatises on foreign trade, industrial topics, ship-building, maritime matters and railroad transportation, his work causing him to travel widely in foreign countries, particularly in South America and the West Indies. He had been until lately Export Sales and Advertising Manager of the United States and Cuban Allied Works Engineering Corp. and the Krajewski-Pesant Corp. of New York and Havana.

The June issue which has already been distributed is indicative of the improvements contemplated and stands as a living testimonial of the exceptional journalistic ability which Mr. TIETSORT brings to COMPRESSED AIR MAGAZINE.

Mr. FRANK RICHARDS continues on the Editorial Staff as Editor of the Technical Division and Mr. W. L. SAUNDERS as Editor-in-Chief.

CHARLES AUSTIN HIRSCHBERG,
Business Manager.

Mr. John Stevenson, Jr., president, announces that effective as of June 4, the Standard Car Construction Co. and the Standard Car Equipment Co. were merged under the name of the Standard Tank Car Company. The latter company will continue the functions of the two component companies, both as to the building and the leasing of tank cars and all forms of steel plate construction. The head office and works will be at Sharon, Pa., with branches maintained at New York, St. Louis and Chicago.

Owen W. Streett, Bethlehem, Pa., has been appointed assistant to purchasing agent, Bethlehem Shipbuilding Corporation, Ltd., Union Plant, San Francisco, Cal. Mr. Streett has been a buyer of mechanical and electrical equipment at the central purchasing office, Bethlehem Corporation, for the last two years.

Books and Writers

In the Realm of Science as Applied to Industry

JOHNSON'S MATERIALS OF CONSTRUCTION, a Treatise on the Properties, Structure, Identification and Proper Use of All the Important Materials Employed in Construction. Based upon the original work by the late Dean J. B. Johnson of the College of Engineering, University of Wisconsin; rewritten by M. O. Withey, Associate Professor of Mechanics of the University of Wisconsin and James Astor, metallurgist of the A. M. Byers Co. of Pittsburgh; edited by F. E. Turneaure, Dean of the College of Engineering, University of Wisconsin. Illustrated, Fifth Edition, XIX-840 pages. Price, cloth, $6 net. New York: Messrs. John Wiley & Sons.

WHEN DEAN JOHNSON'S original work was published some twenty years ago, he pointed out in the preface that the design of any kind of construction involved a knowledge of three things: the external forces to be resisted or transmitted; the resulting internal stresses; and the mechanical properties of the materials employed. Of these the first two are founded on the sciences of applied mechanics and mathematics, but the third, the properties of materials, does not rest on any deductive science; the information required can only be obtained by exhaustive research.

An immense amount of study and experimental research had been devoted to the properties of materials, but the information existed in many forms and many languages. Dean Johnson's treatise was prepared with the object of assimilating and digesting this information and presenting it to the practising engineer in convenient form for reference. The merit of the work is attested to by the fact that it was used widely for twenty years with little revision.

The present authors have not only brought the book up to date by adding the latest information available, but have also continued the broad scope of the former work by including essential instruction on the sources, manufacture or fabrication of the various materials, providing a book which can be used as a text as well as a reference.

The first chapter is devoted to a synopsis of the principles of Mechanics of Materials, and the various forms of deformation and stress are fully treated. In Chapter Two the newest machines for measuring stress and deformation are fully described and illustrated, and the third chapter gives detailed instructions on methods of testing, including the preparation of test specimens.

The three chapters following are devoted to a discussion of various woods as materials of construction. This section is more complete than in any similar work which has been brought to our notice, and the portions concerning identification of different woods and causes and prevention of deterioration should be valuable to the constructor. Tables showing the holding power of nails and screws in wood are complete and readily understood.

Cements and concrete are then taken up, starting with their manufacture and ending with a discussion of their varied modern uses.

The metals used in construction are fully treated in the remainder of the book. The metal ores and their reduction are first discussed, foundry and rolling mill practise is covered, and the nature and manufacture of alloys treated. Follows a discussion on the constitution and properties of iron and steel, including the alloy steels. The non-ferrous metals and alloys are then described, and the final chapters devoted to the effect of temperature, fatigue and corrosion of metals.

As a reference work on the materials used in construction, the book leaves little to be desired; since it is also designed to be used as a text, however, it is surprising that the book contains so few references to the uses of air. Compressed air is second only to steam and to electricity in this age, and plays an important part in many of the processes described in Johnson's Materials of Construction. For instance, the work makes no mention of sand rammers for foundry use, chipping hammers for trimming castings, pneumatic hammers for vibrating concrete forms, or tampers for concrete; the cement gun, and the operations of plating or painting metal for protection by compressed air are not discussed. A brief treatment of these subjects would in our belief, be merited.

—*W. P. B.*

THE SHOP COMMITTEE, a Handbook for Employer and Employee, by William Leavitt Stoddard, A. M. 125 pages. Price, cloth, $1.25 net. New York: The Macmillan Company.

IN THE PRESENT days of social unrest, any work which aims at a real practical solution of the problem of adjustment of disagreements arising between employer and employee is as refreshing as a breath of cool air on a warm day. Undoubtedly "The Shop Committee" is a step in the right direction, and Mr. Stoddard's book is valuable in that it seeks to explain the previous work that has been done, and to present in a logical way the difficulties involved, with suggestions for their solution.

The author states in his preface that his work is neither a treatise, a history, nor a complete study of the shop committee movement. This may be true, but enough material is presented to afford the careful reader an ample knowledge of the subject. Mr. Stoddard was administrator for the National War Labor Board in 1918 and in 1919, and many of the experiences related are drawn from personal observation.

The volume commends itself particularly to shop superintendents, managers and foremen, and it is to be hoped that it will enjoy a large circulation in its chosen sphere.

KEYS TO SUCCESS, Personal Efficiency, by B. C. Forbes. 250 pages. Price, cloth, $2 net. New York: B. C. Forbes Publishing Company.

THIS BOOK is inspirational in character, and contains many valuable suggestions for personal betterment. It offers no easy road to success, but indicates all the difficulties and trials which beset the path of the ambitious toiler. Many successful men are quoted and examples are taken from their success.

The work reads like a modern Book of Psalms. Most of the chapters consist of an array of gems of thought, succinctly stated, and arranged in order, forming what might be called a psychic piece of jewelry.

The reading of a single chapter every evening ought to help to produce an inspired state of mind and prove an aid to clear and right thinking.

HEAT TRANSMISSION TABLES, compiled by William R. Jones, Superintendent of Buildings and Grounds at the University of Pennsylvania, 23 pages. Price, paper $1.

THESE TABLES first appeared in the *Heating and Ventilating Magazine,* in four issues from October, 1918, to January, 1919. In their present form, they form a valuable reference for the engineer or contractor. The data is digested from the most recent experimental work in many lands, and arranged in a most convenient way.

Many materials and combinations of materials in the shape of windows and doors, walls and floors and other construction forms are considered in the tables. The builder will find in them a form closely approximating any he may wish to use, and thereby make his heating calculations easily and quickly.

MARINE GAS ENGINES, their Construction and Management. A Practical Treatise on the Construction, Installation and Operation of Internal Combustion Engines of the Marine type, by Carl H. Clark, S. B., 102 Illustrations, v-136 pages. Second edition, revised and enlarged. Price $2 net. New York: D. Van Nostrand Company.

MR. CLARK evidently has had in mind, in preparing this work, the well-nigh universal desire to understand gas engines by the man with little or no technical education. The types of engines and their principles of construction are clearly presented without resort to the theoretical viewpoint. Ignition devices and wiring are explained with numerous diagrams, and lubrication is similarly treated. Some space is devoted to reversing mechanism and propellers, owing to the fact that these must be carefully considered in connection with marine engines.

Modern heavy oil engines and multiple-cylinder engines are described and their peculiarities pointed out, and the final chapters contain some excellent notes on the installations and operation of internal combustion engines.

This work ought to prove especially valuable to the owner or prospective owner or operator of a motorboat or auxiliary-motored craft. It is issued as one of Van Nostrand's Nautical Manuals.

"Principles of Combustion in the Steam Boiler Furnace" is the title of a new work by Arthur D. Pratt, of the Babcock & Wilcox Co., which publishes the book. As assistant to Dr. D. S. Jacobus, that company's advisory engineer, Mr. Pratt devotes much of his time to combustion and heat-transmission problems. The book, therefore, embodies much of the company's practice. This excellent book is in thirteen sections, dealing with the chemistry of combustion, density, weight and volume of gases, heat of combustion, specific heat, temperatures developed in combustion, air and combustion, combustion formulas, combustion loss, smoke, general conclusions.

Section XII deals with the computation of combustion data relative to coal, wood, oil, natural gas, byproduct coke-oven gas and blast-furnace gas. Section XIII treats of the heat balance for solid, liquid and gaseous fuels. These two sections are particularly valuable.

THE MIND DRIVER

A Word with Industrial Employers

BY *D. C. GROVE*

GILBERT K. CHESTERTON tells us that the proper hiding place for a leaf is in a forest with countless other leaves screening its identity with their numerical infinity.

The ambition of a man, the driving force of mind, too often goes into hiding in a forest of other leaves which bear it semblance, although they are of coarser strain. Too often is it hidden in the jungle shades covered by the rotten vegetation of fear and racial antipathy and deeply rutted by convention and custom. Yet it is always there, still green though perhaps dormant or sleeping.

D. C. GROVE.

In that physical reflection of a higher creative intelligence known as mind, the ambition of the worker resides as a subtly delicate balance, tipping on one side to the weight of encouragement and responding as readily on the other, to the heaviness of opposition. Just as surely as an assault upon the person is an unabidable offense in the sight of man, the deliberate suppression of ambition in another, a battery of the mind, is a crime in the sight of God.

If the mind of man could be arranged as a motion picture film and coördinated trains of thought projected upon a screen, it would be found that behind all mental process appears the nimbus of ambition, urging the thinker to "carry on."

Who can gainsay the supposition that the Fiji Islander in his barbaric simplicity has ambitions as near and dear to him as those which inspire art and drama in the minds of genius.

Are not the prattling ambitions of the growing boy to belong to the brass-buttoned grandeur of the fire department as serious to him as the dream of the ingenue of her name in flashing signs along the Great White Way?

In the autobiographies of successful men and women how often do we find the whole secret of success lying in perhaps a few words of timely encouragement given them at a crucial time by some one in the long ago.

To employers of labor is given the divining rod of power, the forked symbol of authority and guidance. Use this with sympathetic understanding; stir the tangled refuse of the forest floor of mind and rescue or revivify the wind blown seedling of ambition in the millions to whom you act as guide and mentor.

Personal Intelligence

Mr. J. W. McCabe, who until recently has been district manager of sales for the Chicago Pneumatic Tool Company, at Buffalo, New York, has been appointed special representative for the company's foreign trade department and will depart shortly for an extended trip throughout the Orient, Philippine Islands and Australia. Mr. W. H. White has been appointed acting district manager of sales at Buffalo to take charge of that territory during Mr. McCabe's absence.

* * * *

The Walter A. Zelnicker Supply Company in St. Louis has just appointed Mr. F. X. Meehan as Advertising Manager. Mr. Meehan comes to the Zelnicker organization with a very broad experience, having been associated, in various executive capacities, with Fairbanks Morse & Company, for six years; the Santa Fé R. R. Coast Lines, for two years; and St. Louis Smelting & Refining Works of National Lead Company for two years. Mr. Meehan was an active Four-Minute-Man during the World War, having made over 500 patriotic speeches.

* * * *

Daniel H. Cox, having resigned his position as manager of the Ship Construction Division of the United States Shipping Board Emergency Fleet Corporation, has resumed his original business with the firm of Cox & Stevens, naval architects, marine engineers and vessel brokers, 15 William street, New York city.

* * * *

Messrs. Wm. B. Scaife & Sons Company of Pittsburgh announce the opening on July 1 of a Chicago sales and engineering office at No. 38 South Dearborn street, with Charles F. O'Hagan, formerly chief engineer of the company at Pittsburgh, as resident engineer and manager.

* * * *

G. A. Tomlinson, the well known Great Lakes shipping man, formerly of Duluth, has resigned as director of the Inland Waterways and Canals Division, which is under the jurisdiction of the United States Railway Administration, to become resident director of the London office of the American Shipbuilding Company.

Professors Lambert and Carlson, of the Minnesota School of Mines, are heading the sophomore class of the school during their annual six weeks of practical work. They are at present at the Scranton mine, in Hibbing, studying the underground lay-out.

CONFIDENTIAL EMPLOYMENT BUREAU

With the hope and expectancy of being of real assistance both to employers seeking efficient help and to competent and experienced men in the industries in which compressed air is employed, this magazine has decided to reopen its Confidential Employment Bureau, abandoned in the course of the war. As the only periodical devoted to the subject, Compressed Air Magazine will be glad to bring employers and good men together, and without charge for its services.

While we cannot assume responsibility, we shall use our best judgment respecting the credentials of those whose wants come to the attention of the re-established bureau.

Applications from either employers or employees should be directed to "Confidential Employment Bureau," Compressed Air Magazine, No. 11, Broadway, New York City. Each employment "want" will be numbered in the order of receipt and published in the next issue.

Letters in response to numbered requests will be forwarded direct to the person or persons concerned. Requests for publication must be received not later than the fifth of the month preceding date of issue.

HELP WANTED

No. 418—Channeler runner and general mechanic on quarry work required by a New England concern. Married man preferred. Must be steady and reliable. Good wages.

No. 419—Services of young graduate mechanical engineer well versed in compressed air practice and having had some experience in shop work sought by Pennsylvania factory. Write Bureau giving full details. Salary, $150 monthly to start.

No. 420—Colorado mine superintendent seeks experienced assistant. Give history, schooling. State salary expected and how soon available.

POSITIONS WANTED

No. 843—Good drill repair man wants place in far west or Rocky Mountain states. Can give excellent references.

No. 844—Engineer for building contractors, familiar with engines, hoists and compressors wants a steady position with responsible firm of contractors or engineers. Speaks and writes French and Spanish. Willing to travel.

No. 845—Engineer major, A. E. F., discharged with excellent record, seeks place with large manufacturing house in the eastern states. Fifteen years' practical experience in general mechanical engineering prior to war. Has dependent wife and two children and will accept any reasonable offer.

No. 846—Experienced man in running air compressors would like a job as compressor engineer. Employer for eight years out of business. Good references.

Latest U. S. Patents

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

Notice to Readers:—With a view to ascertaining sentiment on the subject, we should be glad to learn from subscribers whether they consider that the space now devoted to the record of pneumatic patents is well used. It has been proposed to abolish the publication of these patents in this journal, as there is a considerable pressure on our space capacity, and there has been a suspicion that not a sufficient number of readers were interested in them, or found them of value, to make their publication worth while. If those interested in the continuance of their publication will write us we shall be very glad indeed to consider their opinions.—The Editors.

APRIL 8

1,299,443. VACUUM FUEL-FEED SYSTEM FOR MOTOR-VEHICLES. Wray Falwell, Fitchburg, Mass.

1,299,477. FLUID-MOTOR. James Blaine Kendall, Chicago, Ill.

1,299,478. AIR COMPRESSOR. James B. Kendall, Chicago, Ill.

1,299,495. SAND-BOX VENTILATOR. Charles F. Mather, Erie, Pa.

1,299,547. VACUUM-CLEANER. Homer L. Boyle, Lansing, Mich.

1,299,653. VACUUM-TANK FOR FUEL-FEED SYSTEMS. George A. Arnold, Boston, Mass.

1,299,659. AIR DIFFUSER AND REGULATOR. Frank A. A. Barrs, Vancouver, British Columbia, Canada.

1,299,668. AIR LIFTING-JACK. August Blomquist, Vancouver, British Columbia, Canada.

1,299,671. DEVICE FOR THAWING DRAIN-PIPES. Lewis A. Brennar, Brandonville, Pa.

1,299,791. DRYING PROCESS. Stewart E. Seaman, Brooklyn, N. Y.

1,299,814. FEEDING MEANS FOR DRILLS. Lewis C. Bayles, Easton, Pa.

1,299,883. FLUID-OPERATED LATHE. Henry E. Warren, Ashland, Mass.

1,299,900. COMBINED FUEL AND AIR VALVE. George F. Bibb, Troy, N. Y.

1,299,901. AIR-GUN. Benjamin L. Blair, Indianapolis, Ind.

1,299,946. PNEUMATIC ATTACHMENT FOR SCHUTCHING-MACHINES. John Hubler, Brandon, Wis.

1,300,014. SPRAYING DEVICE. James W. Ranson and Otto A. Gerstung, Chicago, Ill.

1,300,016. METHOD OF AND APPARATUS FOR ENGINE-BRAKING. George B. Reed, Philadelphia, Pa.

1,300,053. AIR-LIFT PUMP. Ralph H. Tucker, Los Angeles, Cal.

1,300,073. AIR COOLING SYSTEM FOR AUTO-ENGINE CYLINDERS. Edward T. Wheeler, Akron, Ohio.

1,300,196. SUCTION-CLEANER. William W. Rosenfield, New York, N. Y.

APRIL 15

1,300,281. FLUID-PRESSURE APPARATUS. Amos L. Knight, Philadelphia, Pa.

1,300,523. LOW-PRESSURE ALARM. William E. Voss, Oklahoma, Okla.

1,300,529. FLUID-PRESSURE SYSTEM. James N. Weikly, Jersey City, N. J.

1,300,654. DRY-SPRAYING MACHINE. William H. Rose, Jersey City, N. J.

1,300,705. DEVICE FOR CHILLING AND DRYING AIR. Benjamin Joshua Du Bose, Lisbon, Ga.

1,300,727. PNEUMATIC SPRING. Josef Hofmann, Baumaroche, Switzerland.

1,300,821. VACUUM CASTING-MACHINE. Louis R. Curtis, Chicago, Ill.

1,300,823. SPRAYING APPARATUS. Arthur V. Dickey, Seattle, Wash.

1,300,898. FLUID-PRESSURE CLUTCH. Bee Elmer Vincent, Swifts, Ohio.

APRIL 22

1,301,130. METHOD OF AND APPARATUS FOR DRYING MATERIALS. Harry E. Hollister, Irvington, N. J.

1,301,131. FLUID-CONTROL APPARATUS. Philip T. Jackson, Toronto, Ontario, Canada.

1,301,167. SEMI-AUTOMATIC COMPRESSED-AIR TRANSPORT SYSTEM. William O. Renkin, Oradell, N. J.

1,301,208. CAR HOISTING AND DUMPING APPARATUS. Alexander H. Wood, Petros, Tenn.

1,301,209. DRAINAGE DEVICE FOR VACUUM-PUMPS AND THE LIKE. Euclid P. Worden, Montclair, N. J.

1,301,241. METHOD FOR REMOVING BULGES AND SWELLS FROM CANS AND TESTING THE SAME FOR LEAKS. Charles E. Fenlon, Grays Lake, Ill.

1,301,242. TIRE-PUMP. Jesse T. Fiese, Fresno, Cal.

1,301,272. METHOD OF DELIVERING A MIXTURE OF GAS AND AIR. George Keith, London, England.

1,301,290. BRAKE-OPERATING MECHANISM. Ezra B. Mead, Ottumwa, Iowa.

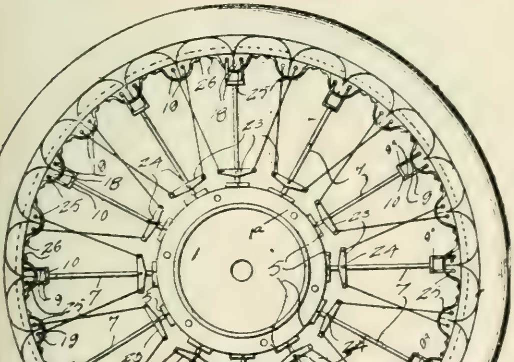
1,301,319. VACUUM CLEANING-BRUSH. James P. Quam, Milwaukee, Wis.

1,301,327. PNEUMATIC ELECTROMAGNETIC GUN. Thomas B. Slate, Washington, D. C.

1,301,369. VACUUM-TANK. Clifford C. Bradbury, Oak Park, Ill.

1,301,385. FLUID-DISPENSING CONTROL. John J. Catron, Bonham, Tex.

1,301,427. VACUUM-UNLOADER FOR RAILWAY-CARS AND THE LIKE. Frederick Girtanner, St. Louis, Mo.



PATENT NO. 1,302,265

1,301,515. INFLATABLE MARINE LIFE-SAVING APPLIANCE. David Joseph Smith, London, Eng.

1,301,594. DRYING-MACHINE. Bertrand A. Parkes, Philadelphia, Pa.

1. In a drying machine, the combination of a drying chamber; a conveyer for the material to be dried passing through the said chamber, means for forming festoons upon the conveyer; and an air nozzle cooperating with the said festoon forming means.

1,301,614. MOTOR FOR VEHICLES. Frank A. Snyder, Pittsburgh, Pa.

In a pneumatic motor for vehicles, the combination of a cylinder and piston, devices for connecting the piston with the running gear of the vehicle, a low pressure air reservoir connected with the cylinder, an air compressor and an auxiliary motor for driving the same, a high pressure air reservoir connected with the cylinder and with the air compressor, a connection between the cylinder and the low pressure reservoir, connections between the auxiliary air compressor and the low and high pressure air reservoirs, and devices for opening and closing the connections.

1,301,723. AUTOMATIC DECELERATING AIR-BRAKE EQUIPMENT. George Macloskie, Erie, Pa.

1,301,751. AIR-PUMP. Patrick M. Scanlan, Brooklyn, N. Y.

1,301,794. COOLING SYSTEM. Chester Rowell Sutton, Tucson, Ariz.

APRIL 29

1,301,804. PNEUMATIC SUSTAINING MEANS FOR VEHICLES. William H. Bates, Vancouver, Wash.

1,301,980. SAND-BLAST APPARATUS. Paul Schroeder, Chicago, Ill.

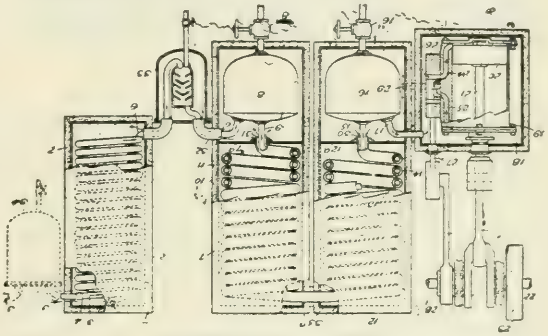
1,302,019. DRILL-SHARPENER. Jesse Ditson, Littleton, Colo.

1,302,053. FEEDING MECHANISM FOR MIXING-MILLS. William Jameson, Chicopee Falls, Mass.

1,302,192. VACUUM-CLEANER. Francis C. Mason, Grand Rapids, Mich.

1,302,265. PNEUMATIC WHEEL. Samuel B. Zartman, Niles, Mich.

1,302,268. APPARATUS FOR ELEVATING FLUIDS BY COMPRESSED AIR. Herbert T. Abrams, Orange, N. J.



PATENT NO. 1,302,430

1,302,430. METHOD OF OBTAINING TEMPERATURE CHANGES IN GASES. Alexander S. Ramage, Detroit, Mich.

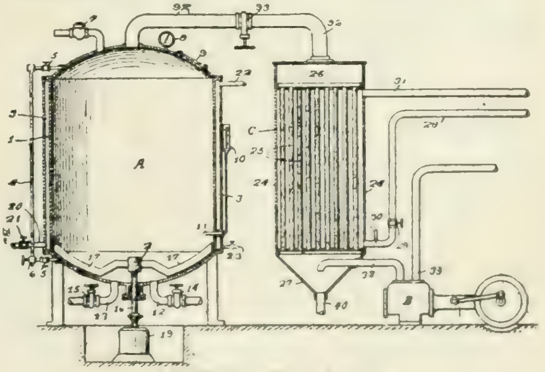
1. A method of fractionally liquefying gases, which consists in expanding adiabatically successive charges of a mixture of two or more gases, and surrounding the charge undergoing expansion with the next succeeding unexpanded charge and thereby effecting a heat exchange which produces an accumulative lowering effect on the initial temperature of successive unexpanded charges, whereby the temperature of the mixture is reduced by successive stages so as to separately liquefy and recover said gases.

MAY 6

1,302,511. ELECTROPNEUMATIC ORGAN-VALVE. George H. Chapman, Chicago, Ill.

1,302,515. METHOD AND APPARATUS FOR HUMIDIFYING AIR. George W. D'Arcy, Boston, Mass.

1,302,521. AIR-BLAST GEAR OF BREECH-LOADING ORDNANCE. Arthur Trevor Dawson and George Thomas Buckham, Westminster, London, England.

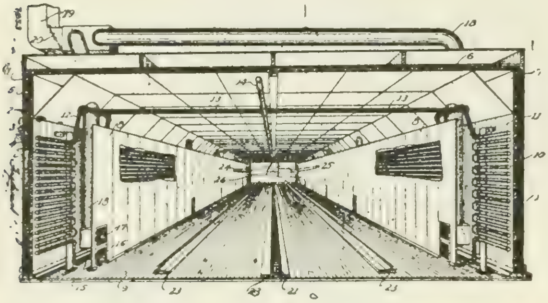


PATENT NO. 1,302,519

1,302,549. PROCESS FOR BREWING BEER. Herman Heuser, Chicago, Ill.

6. In the manufacture of alcohol-reduced beer, the process which consists in simultaneously boiling and fermenting the wort *in a vacuum* and at yeast fermentation temperature to preserve live yeast in the beverage, stopping the combined fermentation and boiling of the wort when it contains a predetermined amount of fermentable elements, and then completing the fermentation of the wort at atmospheric pressure.

1,302,610. VACUUM FEED APPARATUS. Frederick Weinberg, Detroit, Mich.



PATENT NO. 1,303,078

1,302,711. AUTOMATIC PNEUMATIC SEMAPHORE AND TRAIN-STOP MECHANISM. Fred D. Robb, Dothan, Ala.

1,302,716. DUST-SEPARATOR. Charles E. Sargent, Indianapolis, Ind.

1,302,780. AIR-LIFT PUMP. Levi T. Edwards, Philadelphia, Pa.

1,302,823. LIFE-PRESERVER. Frank Marcovsky, Duquesne, Pa.

1,302,889. AIR-MOTOR. Jose Antonio Albisu, Saladillo, Argentina.

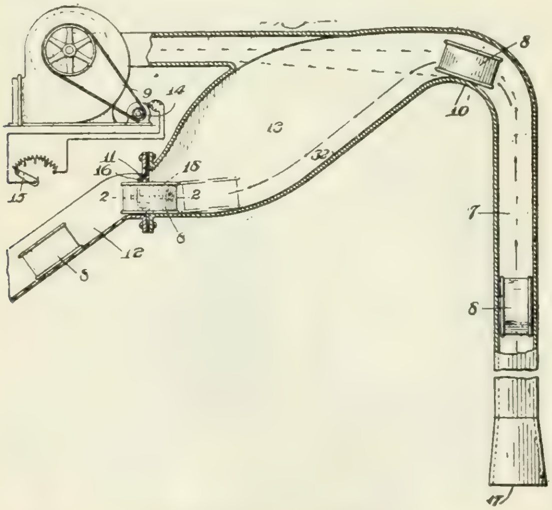
1,302,929. SUCTION-CLEANER. James B. Kirby, Cleveland, Ohio.

1,302,984-5-6. TRIPLE VALVE. Jacob Rush Snyder, Pittsburgh, Pa.

1,303,059. SUCTION CLEANING DEVICE. Frank C. Helmich, Philadelphia, Pa.

1,303,078. DRYING-ROOM. Frederick A. Lippert, Chicago, Ill.

1. In an apparatus of the class described, the combination of an elongated drying chamber, means for conveying articles to be dried lengthwise through said drying chamber, means partly closing the ends of said drying chamber and formed to provide an opening approximating in shape and dimensions the silhouette of the articles to be dried and the conveying means therefor, and means for causing heated air to circulate through said drying room transversely to the length thereof.



PATENT NO. 1,303,604

1,303,201. CLEANING DEVICE. Albert E. Hobbs, Chicago, Ill.

1,303,207. APPARATUS FOR SEPARATING OIL FROM AIR IN AIR-COOLED SYSTEMS FOR MACHINERY. William Patrick Kelly and Denis Clement Slattery, Wexford, Ireland.

1,303,209. EVAPORATOR. Ralph W. King and Herbert G. Miller, The Dalles, Oreg.

1,303,210. VENTILATING APPARATUS. Albert R. Klein, Springfield, Mass.

MAY 13

1,303,297. APPARATUS FOR PNEUMATIC CONTROL. Walter G. Haas, Dayton, Ohio.

1,303,443. ELASTIC-FLUID METER. Walter Jacob Wohlenberg, Lincoln, Nebr.

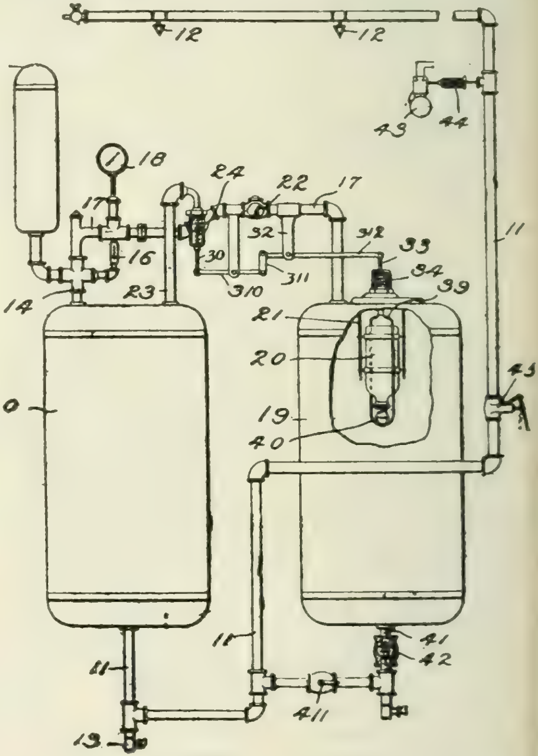
1,303,604. TRANSLATING MATERIAL. Mirabeau Sims, Llanerch, Pa.

1. The method which consists in delivering a receptacle by pneumatic pressure to a discharge port and automatically maintaining said discharge port closed by said receptacle against the admission of air until and during the movement of another receptacle thereto.

1,303,705. ROCK-DRILL. Wilhelm Mauss, Johannesburg, Transvaal, South Africa.

1,303,743. AUTOMATIC CONTROLLER FOR AIR-BRAKE EMERGENCY-VALVES. George Franklin Van Meter, Indianapolis, Ind.

1,303,765. AUTOMATIC FIRE - EXTINGUISHING APPARATUS. Edward R. Brodton, Washington, D. C.



PATENT NO. 1,303,765

1. In fire apparatus, the combination of a holder for an extinguishing fluid having a normally closed outlet, means for maintaining such fluid under pressure tending to cause its efflux, a metal bellows whose interior is exposed to such pressure, consisting of a cylindrical shell with crimped side walls, one end of the shell being closed and the other open, means for clamping the edge of the open end of the shell comprising a cap with a sleeve extending within the shell, and which is perforated to communicate with the interior of the shell, and an external device adapted to be actuated by said bellows and connected with the closed end of the shell.

1,303,818. PNEUMATIC CARPET-SWEEPER. Victor J. Johnson and Eric G. Thoreen, Worcester, Mass.

1,303,819. PNEUMATIC DUST-COLLECTOR. Victor J. Johnson and Eric G. Thoreen, Worcester, Mass.

COMPRESSED AIR MAGAZINE

Vol. XXIV AUGUST, 1919 No. VIII

The Air Receiver

By FRANK RICHARDS

AN AIR receiver connected with an air compressor would seem to be about as simple a thing from the engineer's view-point as can well be imagined, and yet there are many things which might be said, and some which should be said and reiterated, concerning it, its function and relations as essential to be borne in mind in the interest of correct and profitable practice.

The first detail to be specified concerning an air receiver for any given service is as to its size or volumetric capacity, in which particular it is at once as different as possible from a steam boiler; for while there are rules and formulas innumerable to determine the capacity of the latter there are no such rules for an air receiver, and in the nature of things none could be expected. If we were called upon to suggest a rule for air receiver capacity we would say, have it as big as possible, and even then its size would not be of much help.

COMPARATIVE CAPACITIES OF RECEIVER AND COMPRESSOR

Say that we had an ordinary single-stage air compressor with an air cylinder 24-in. in diameter running at 400 ft. per min. piston speed. Its free air capacity would roughly be about 1200 cu. ft. per min., and its delivery at 6 atmospheres or 75 lb. guage, (after the air was cooled) 200 cu. ft. per min. An air receiver 5 ft. in diameter and 10 ft. long, which would be fully as large as would ordinarily be provided for such a compressor, would have a capacity of 196 cu. ft., only 164 cu. ft. of which, at 75 lb., would be in excess of the normal atmosphere content of the receiver, so that the total receiver capacity would be decidedly less than one minute's output of the machine. With the air not cooled, as would be the case, the deficiency would be still greater.

With a two-stage compressor of the same free air capacity and compressing to 8 atmospheres, or, say, a little above 100 lb., guage, and the air at least partially cooled, the receiver capacity as above would more nearly approximate the one minute output of the compressor. But the futility of installing the air receiver for storage purposes, besides its necessarily insufficient capacity, lies in the fact that the pressure of the contained air falls immediately with any withdrawal of the air, or, if in continuous operation, whenever the output exceeds the intake.

It happens that wherever compressed air is employed for operating rock drills, pneumatic tools, hoists or other devices, the call for the air is irregular and intermittent, and the problem of maintaining a constant pressure is a difficult one, and yet one of great importance. An obvious method, and perhaps the first to be thought of, would be to have the compressor capacity approximately equal to the maximum demand, and then to trust to the safety valve to dispose of the surplus when the air consumption fell off, but that of course would be crude and costly. Automatic speed regulation of the compressor usually does not give a sufficient range, and the fractional unloading of the air cylinder is more or less of a makeshift character.

CONSTANT PRESSURE IN THE RECEIVER

By the aid of static water pressure, which is usually available or can easily be provided, a constant pressure may be maintained in an air receiver whatever the fluctation of its air content may be, of course within the limits of its capacity, and wherever there is any permanency of installation the arrangement should be adopted.

The bottom of the receiver, the vertical type being preferable but not essential, is connected by a pipe of suitable size with an elevated body of water, either a tank provided for the purpose of capacity greater than that of the receiver, or any existing body of water whose surface is at the required elevation. It will be seen that with the receiver partly filled with water and compressed air above it the air pressure will be determined and maintained by the height of the surface of the water in the tank above that of the water in the receiver. Thus, for a pressure of 50 lb., guage, in the receiver, the elevation of the water in the tank should be 107 ft., and correspondingly for any other pressure. There is free communication between receiver and tank, and as the volume of air in the receiver decreases or increases the water in the receiver will rise and that in the tanks will fall, or *vice versa,* to correspond, and no water is consumed or wasted. With the water thus freely flowing back and forth a very slight difference of air pressure in the receiver will occur on account of the varying differences of height of the two bodies of water, and, singularly, the pressure will be the greatest in the receiver when it contains the greatest volume of air and when the water level there is the lowest. With compressors in operation and a constant flow of air passing through the pipes, the air which is being used need not enter the receiver at all if only a free communication between the tank and the receiver is maintained to keep the constant pressure.

The original and most notable employment of this principle was by Bruno V. Nordberg, by whom the arrangement has since been patented, at the group of mines of the Anaconda Copper Company, Butte, Montana. Here a battery of air receivers connected with a large tank of water at the required height maintains a constant pressure of 90 lb. guage, so that the entire compressing system, with a free air capacity of 20,000 cu. ft. per min., might be stopped for half an hour and the full air pressure maintained, against maximum consumption.

AIR RECEIVER CONSTRUCTION

The normal air receiver of the present day is a cylindrical steel shell of a length two or three times the diameter, and often much longer than that if used horizontally, with bumped heads riveted in. When the receiver is large enough to have a manhole both heads are usually inserted with the convex faces of the heads outward, as they should be, but for the smaller receiver the generally accepted custom has been to have one head as it should be and the other head as it should not be, or with the concave face of the head outward, just for the convenience of the riveter in manufacturing, a thing for the mechanical world to be ashamed of. The later developments of welding processes remove the last excuse for receivers so constructed, and, indeed, we may hope to see rivets entirely discarded in air receiver construction.

Every air receiver before being put into service should be subjected to a hydrostatic test to a pressure considerably above that to which it will ever be subjected when in use, and in determining what shall be the test pressure limit it will be well to consider that working conditions are more strenuous than the quiescence of the shop. There is liable to be more or less shock or jar, and especially there are possibilities of a great range of temperature changes, and also in course of time the receiver will be weakened by rust, all of which particulars should be allowed for, with an additional factor of safety above that. Commercial considerations make it inadvisable for the present writer to attempt to fix the precise test pressure limit to be adopted in any case.

EXPLOSIONS FROM STATIC PRESSURE

The subject of air receiver explosions is an interesting and important one; and first of all we need a discriminating definition of the word "explosion," for so-called explosions of air receivers occur under two entirely different sets of conditions and with differences of result and consequences which are almost incomparable.

First, there is the letting go of the receiver and the sudden escape of the air when its pressure at the moment is greater than the material of the receiver can withstand, all other conditions being presumably normal. The air pressure from some cause may have become greater than ever before, or the receiver may have been insidiously weakened. With so small a margin of safety as has usually been deemed sufficient it is little wonder that these static pressure explosions should occasionally occur. When such an explosion does take place the results to the surroundings are usually much less serious than when a pressure explosion of a steam boiler occurs, because there is nothing but the confined air to escape, while in the steam boiler there is not only the actual steam in the space above the water but this is followed up by more steam instantly generated from the hot water and also frequently this is backed by the rush of masses of the water itself.

EXPLOSIVE IGNITIONS

The fixing of working pressure limits, the safety valves and other precautions which should be provided, guarantee only immunity from explosions of the preceding type, and are of little account when there occurs the firing of an explosive mixture of air and oily vapor within the receiver or its connections. Concerning explosions of this character there is much more to be said, and investigations of causes must have to do with much more than with the receiver itself. We must begin in fact with the beginning of the air compression, and even outside the compressor where the man in charge doses the machine with the lubricating oil; for in the use of the lubricant in the compressor lies either danger or safety, and much which has to do with the ultimate economy and safety of the entire compressed air system.

It is encouraging to be able to note that the troubles attributable to the lubricant used in air compressors have been greatly reduced, especially when the vast increase in the number of compressors and in the volume of air used is considered, and perhaps we may more readily comprehend why this is so by comparing what might be called the ancient and the modern styles of practice in air compression. These lie not farther apart than a single generation of men, with no distinct demarkation between them, so that there are still survivors of the primeval to discredit the present.

THE ANCIENT AIR COMPRESSOR

The typical compressor of the earlier type which we here have in mind, supplying air mostly to rock drills in mine or tunnel, was a single stage machine compressing the air to, say, 90 lb. guage, without any cooling devices for the air, and little thought was given to the effects of the presence of the lubricant except for the actual lubrication, and, as a consequence, the oil was used "liberally." Now, the oil which is fed into the air cylinder has no discharge or escape except into the air itself by which it is caught up and carried along. At the point of its leaving the cylinder and immediately thereafter the heat of the air is sufficient to decompose the oil and leave the carbon to accumulate as a black sticky mess of combustible material lining the air passages and the interior of the receiver, while the more volatile constituents of the oil are carried along by the air to wherever it is finally discharged. As to the latter, there is an authentic court record that a man in an Alabama coal mine was fatally asphyxiated by the oil fumes in the exhaust of an air driven steam pump, and heavy damages were collected.

Under the system of high pressure, single stage compression which formerly prevailed it was undoubtedly necessary to use much more oil than in these days when such high temperatures and undivided pressures are avoided, and with the extravagant use of lubricating oil above spoken of the carbon deposit accumulated rapidly in the air receivers, and it was a frequent occurrence to have the material take fire and burn with such sudden fierceness that the receiver became visibly red hot. It may have been the products of combustion resulting from such a fire that asphyxiated the miner spoken of above.

It is not worth while to inquire how ignition could occur in such a case, as the heat of the compression and the presence of six times or more the quantity of oxygen per volume of air would alone be almost sufficient to account for it. The stopping of the compressor would of course stop or smother the fire at once for lack of fresh air.

Receiver explosions in connection with such fires did not generally occur. In one case there was a vertical receiver with the convexity of the head facing inward, and when the fire occured the pressure of the air reversed the curve of the head and the receiver was lifted entirely clear of its support. Another receiver, horizontal, actually seen and photographed, after the event, by the present writer, about 2 ft. in diameter and 5 ft. long, had a similar concave head which became red hot and while hot was reversed by the pressure, the reversal occurring with such a snap that the head was torn out entirely clear of the shell.

TWO STAGE COMPRESSION

So much for the ancient and obsolete or obsolescent practice. The modern way is to have two stage compression for the ordinary working pressures, say from 5 to 8 atmospheres, with efficient cooling of the air between the stages. By this arrangement the high temperatures are avoided, the oil has better lubricating effect, is retained longer upon the friction surfaces and less oil is required. More intelligent and careful supervision also is exercised as to the systematic feeding of the oil, and, as an essential detail, careful records are kept.

It might appear in the light of present, up-to-date practice that the function of the lubricant in the air cylinder is not altogether clear. The impression has been that more or less oil must always be present upon the friction surfaces. This belief it is not easy to retain in the face of some indisputable records. On the Panama Canal work the tabulated records show 1,887,513 square feet of cylinder surface swept by the piston per pint of oil used. This area is about 40 acres, and we cannot imagine a pint of oil could be made visible or otherwise discoverable if spread over such an expanse. A compressor of the Nevada Consolidated Copper Company has more recently showed a rate of lubricating oil consumption only one-third of the above. At the present time there is more or less discussion current, which we will not here go into, as to the quality of the oil most suitable for air compressors, our impression being that quantity rather than quality must be the determining characteristic. It is neither high flash-point nor low flash-point, but, rather, no flash-point that will guarantee absolute safety.

The explosions in compressed air systems which result from the formation and then the ignition, or firing-off, of an explosive mixture which is composed of volatilized hydrocarbon from the oil intimately mixed with the air in receiver or piping, are very different from those which are caused by a slowly developed excess of pressure, and safety-valves, and other precautions against pressure alone, are of no avail when the instantaneous ignitions occur. The latter also are much the more dangerous and destructive, and therefore the more requiring investigation.

The lubricating oil which is fed into the compressor cylinder must be constantly in contact with the air passing through, and under the heat which develops in the compression some portion of the oil is converted from the liquid into the gaseous state, this portion mixing with the air and forming the explosive mixture under consideration. It may be reckoned a providential circumstance, otherwise taken advantage of in the gas engine, that the proportions of oily vapor and of air to form a mixture that will be explosive are quite narrowly limited. It may be said, generally, that if more than 5 or 6 per cent. of the oily constituent is present in the mixture it will not be explosive; and it should be quite permissible for us to infer that many explosions which might be predicted do not take place on account of excess as well as of deficiency of oil vapor in the mixture.

But, supposing the potentially explosive to be present in the required proportions and ready to go off, there is still the actual firing of the charge to be accounted for, and here, an account of the deficiency of actual knowledge, there is still more or less of mystery. We do not know with any precision the temperature required for ignition and we cannot intelligently suggest how igniting spark or flame could be produced.

There are widely distributed data concerning the flash-points of oils and also the so-called "burning" points, but beyond these there is also a temperature at which spontaneous ignition of an explosive mixture will result without spark or flame and started by the high temperature alone. This is, indeed, the keynote of the Diesel engine, but the principle can hardly be said to have diffused itself through the familiar strata of popular engineering knowledge.

It is to be remembered that rise of temperature accompanies the compression of air regardless of the means by which the air is compressed. In a certain coal mine in Pennsylvania a compressed air locomotive was employed for haulage. The mine was piped with air at a constant pressure of 1000 lb., and at different points in the mine there were stations at which the locomotive could make connection and have its tanks recharged to 600 lb. Upon one occasion of such recharging there was a fierce explosion with fatal result. There was a general disposition to dismiss the incident as an inexplicable mystery, and all the details of it were never fully investigated and explained.

There was in the case, however, sufficient suggestion of how the high temperature we are here looking for might have been produced. We may assume that in this case oil was used with little thought as to its possibilities and that oily fumes were diffused through some portions of the air remaining in the locomotive and that there was a small space somewhere in which the oily air was compressed at once by the inrush of the new air to the full recharging pressure with corresponding rise of temperature, perhaps approaching 1000 degrees F., and then the conditions were complete for the spontaneous ignition and the resulting explosion, and the catastrophe was inevitable.

To account in another way for a self-igniting temperature, not necessarily resulting in an explosion since the explosive mixture might not be present, some ingenious person has invented the hypothesis of the leaky discharge valve as sufficiently explanatory, and the hypothesis is at different times commandeered by various writers. It is assumed that the heat of compression has produced from the oil a solidified carbon deposit which has accumulated and caked upon the discharge valves and cages, causing the valves to stick and fail to close properly. This we know well enough is a not infrequent occurrence, especially with single stage machines compressing to six or more atmospheres, which was once the practice. But in connection with this sticking of the discharge valves it is further assumed that, notwithstanding that the compressor goes on taking in, compressing and delivering air, although perhaps in somewhat diminished quantity, a certain portion of the heated compressed air is caught and separated in some way from the rest and juggled back and forth at each stroke of the machine and constantly being recompressed and getting hotter and hotter apparently without limit until it sets fire to what it may come in contact with. Now, ignoring the fact that such repeated recompressions and accessions of temperature, if they were possible, must necessitate also alternate re-expansions with accompanying depressions of temperature, such a hypothesis should be sufficient to account for almost anything.

MOISTURE IN THE AIR

In dealing with compressed air in any way the problem of disposing of the moisture contained in the air is practically always encountered and imperatively demanding solution. Air taken in to be compressed, free air, is never so dry that it does not prove to be super-saturated after being compressed to five or six atmospheres and allowed to cool to normal temperature, and the air receiver has been popularly regarded as an important agent in disposing of the surplus moisture, but for that service it must be regarded as more or less a disappointment.

THE WORK OF THE INTERCOOLER

To fully appreciate the possibilities and the impossibilities in connection with the air receiver and its attributed functions it may be well to consider the practical operation of the intercooler of the two-stage compressor. Without the intercooler there would be no reason for and no advantage in two-stage compression. The primal argument for the inter-cooler is that it reduces the volume of the air under compression, leaving less work for the high pressure cylinder and thereby saving power. It may as well be conceded that this result alone would scarcely be sufficient to enforce the general adoption of the intercooler, its incidental services being really of more practical value than the mere saving of power.

The reduction of volume effected by the intercooler is merely a consequence of the reduction of temperatures, but the reduction of temperatures is in itself a great good accomplished. The deposition of the carbonized residuum of the oil upon the valves and in the air passages is greatly reduced and the spontaneous ignition of the oily deposits or the firing of explosive mixtures which might be formed is rendered practically impossible. The lubricating oil also remains in better condition and lasts longer upon the friction surfaces, so that less oil is required.

CONDENSING THE MIXTURE

The cooling of the air in the intercooler for the primal purpose of reducing its volume also provides the conditions most necessary for the separation and extraction of the moisture carried by the air. Up to the point of complete saturation of the air, the water carried by it and which in greater or less quantity is always present, is in the form of steam. Not steam under the conditions with which we are most familiar with its boiling point at 212 degrees, but yet true steam. We must remember that under varying conditions water may have its boiling point and its point of recondensation anywhere either above or below 212 degrees. It is true steam carried by the air and normally with all the accompanying phenomena of true steam, and the water can be eliminated from the air not by any process of straining or filtration, but, first by the condensation of the steam and then by the deposition and collecting of the water of condensation. Any intercooler is thus a condenser and might properly be so called, whatever its construction, so far as it accomplished the purpose of converting into liquid the vapor that is mixed with the air.

Very roughly stated, the capacity of air for moisture at the saturation point and at any constant temperature is directly as the volume, or inversely as the absolute pressure. Thus, with free air at 50 per cent. of saturation, and it is generally above rather than below that, it will, at the same temperature, be completely saturated when its absolute pressure becomes 2 atmospheres, or, say, 15 lb. guage, and its volume is reduced to one-half.

But it is to be remembered at the same time that the capacity of the air for moisture is much more rapidly affected by changes of temperature. As a general rule this capacity is doubled with each rise of temperature of 20 degrees Fahr. Thus, in the case just cited, when the air theoretically became completely saturated, so far as the pressure alone was concerned, when a pressure of 2 atmospheres was reached, the operation of raising the pressure of the air by 15 lb. at the same time raised its temperature more than 100 degrees, so that by this rise of temperature the moisture carrying capacity of the air was increased 2x2x2x2x2, more than 32 times.

It will thus appear that the air which comes to the intercooler after its compression in the low pressure cylinder is, on account of its high temperature, in an extremely "dry" condition, although its actual water content has not been reduced in the least. It is so dry in fact that the proposition to relieve it of some of its contained moisture seems almost absurd. And yet, assuming the aftercooler to be properly designed and equipped for its purpose, the parting of the water from the air begins quite early in their transit through the apparatus, and continues with increasing rapidity and until the cooling of the steam-and-water mixture is completed.

The typical intercooler might be any air receiver in which have been mounted a great number of thin metal tubes of small diameter so connected that they are all constantly full of cold water in active circulation, the air which is to be cooled filling the body of the intercooler and surrounding the cooling tubes, it being provided that, by means of baffle plates or otherwise, this air also is constantly in motion along the surfaces of the tubes, or preferably across them with impinging action. It is further arranged that the final emergence of the air from the intercooler is at the end where the cold water enters, thus insuring that the air as it leaves the intercooler shall be at the lowest temperature possible, and little above that of the cold incoming water.

THE CONDENSATION OF THE WATER VAPOR

The cooling action which takes place in the intercooler, when considered in detail, is not at any instant operative upon the entire body of the air at the time contained within the intercooler, but upon successive films of the air which come immediately in contact with the surfaces of the cooling tubes, and hence we may see how the condensation of the vapor and the separation and the deposition of the water may commence immediately that the air enters the intercooler. Steam contained in the free atmosphere will be condensed and globules of water will form upon the outside of a pitcher of ice water carried into a room of normal temperature without perceptibly lowering the mean temperature of the room. In this case a very small cooling surface is presented to a large body of air which contains more or less water vapor, but yet the air immediately in contact with the pitcher is effectually cooled and some of the vapor in it is condensed. The case of the intercooler is the reverse of this. In it small portions at a time of moisture-laden air are caused to flow over large cooling surfaces and the result in kind is the same, but the quantities of moisture released are much greater. As the moisture in the films of air which successively come in contact with the cold tubes is condensed and adheres to the tube surfaces the globules, at first minute, begin to grow larger and then run together to form large drops and these run down and collect at the lowest point, where means must be provided, automatic or otherwise, for removing the water.

AFTERCOOLER AS NECESSARY AS THE INTERCOOLER

The task, or as we see in detail, the several tasks, assigned to the intercooler may be satisfactorily and completely performed, and yet the work it does in the nature of things cannot be more than half the work of that kind requisite to be done. All that the intercooler does is still, to make the job complete, more necessary to be done after the final compression and before the sending out of the fully compressed air to do its work. An air compressing installation cannot in these days be said to fully satisfy the demand upon it when it merely puts out so much air compressed to the given pressure without regard to the condition of the air as delivered.

The air in the first place should be cooled at once as it leaves the compressor to reduce its volume and minimize the friction loss in transmission, which is a small matter in itself, but the cooling of the air secures for it the combination of conditions, highest pressure and lowest temperature, when its moisture carrying capacity is at the minimum, and advantage should be taken of this for drawing off all the water so released, and if this is not done the subsequent inconvenience, delay and other money losing details should be added to the power cost and the other costs of the compression.

Those most intelligently seeking economy in compressed air practice today recognize these things. In the most up-to-date installations will be found not only the receiver, which seems to be inevitable, but also the aftercooler and the moisture separator, each individually supplementing the compressor, and all proving themselves worth while in practice. These things carry no operative expense except for the supply of water, and that is not consumed, but is still usable for any other purpose, so that a more profitable investment could not well be found.

"Flivver" airplanes that will carry two passengers and have a wing spread sufficiently narrow to make possible a landing on a country road are to be manufactured at the Maryland Pressed Steel Co.'s plant at Hagerstown, Md., according to reports. The first plane of this type was witnessed by the July 4 gathering at Towson and is the invention of an Italian. It was the idea of the War Department to use the planes in France, but after the signing of the armistice the inventor was induced to work on a peace plane.

The propagandists of the metric system of weights and measures are at it again with renewed vigor, as if we had nothing else to think about except creating confusion. Our contractors have shown that they can build anything likely to be paid for in any kind of measure.—*R. and L. Engineering.*

According to the estimate of the British Advisory Committee of the Ministry of Reconstruction the existing airplane factories in England are capable of the production of 40,000 airplanes and 30,000 motors a year and are able to supply spare parts for an air force of that size.

Shoe soles with metal coverings were made by Germans during the war. Leather, cardboard, or wooden soles covered with aluminum or iron, not more than 0.01 mm. thick. The weight was the same, but they lost flexibility, became more solid and quite water-tight.

Uses of Compressed Air in the Sugar Industries

By W. A. BECKER

IN MY STUDIES of both cane and beet sugar houses, which were actuated by necessary examination into the pumping end and the handling of the various juices and liquors from one station to another, I have noted the limited use of compressed air in the large modern electrified mills of Cuba. In the raw cane sugar factories, the process of manufacture is quite simple when compared with the sugar refineries or the beet sugar factories, where refined sugar is manufactured direct from the beet.

Nearly all of the larger raw sugar plants of Cuba are now electrified. In these there is use for small portable compressed air outfits with which to blow the dust and dirt from the windings of the numerous motors and generators located all over the plants. There is always considerable *bagasse* dust in the air coming from the last of the series of cane mills when the crushed cane or *bagasse* has practically all of the moisture extracted from it and is conveyed directly to the boilers as fuel.

The writer has seen this dust settle in thin blankets all over a mill. It has a tendency to enter the windings of motors and generators, settle in and around the bearings, and in fact in all nooks and corners, where it in time is likely to be detrimental to the vast amount of machinery necessary to each plant. The main mill rolls and all gearings operate at very slow speed, and this dust readily collects at vulnerable points. The use of compressed air for blowing off accumulations of dust has been found to be a considerable asset to a house. The motors in particular should be blown out every few days.

Some mills also use air for agitating the juice during the liming or alkalizing process, the air being forced to the bottom of the tanks through pipes which are perforated, thus keeping the juice in motion and preventing precipitation of the salts, etc., caused by the addition of lime. The writer has not had occasion to see any mills so equipped, as the usual method is agitation by mechanical means, in which a vertical shaft in the center of the tank, with paddle attached, is rotated, and this provides sufficient agitation so as to prevent precipitation, and also assures a thorough mixture of the milk lime particles with the juices. The settling and precipitation occur in a separate tank after juice is pumped from the alkalizers through heaters to the defficators, which is the name applied to the above mentioned tanks.

Air is also used at times in the tanks where the filter press cakes are broken up in water to allow for the absorption of some of the remaining sugar content in those cakes, the resulting mixture, which is again filtered. Mechanical agitators, however, are more commonly used. In some mills the receivers for the *massecuite* (dense mixture of molasses and sugar crystals) are located immediately beneath the vacuum pans, and beneath these receivers, at a lower level, are located the centrifugals for separating the sugar from the molasses. This construction eliminates the handling of these heavy, viscuous *massecuites*. However, many of the older Cuban mills are not so constructed, as the buildings are rather low and squatty, and this means that the *massecuite* must be moved from the receiver, immediately beneath the vacuum pans, to receivers over the centrifugals at some other part of the mill; or then again, the second and third *massecuites* must usually be conveyed to large open crystalizers, etc.

In these cases, handling by compressed air appears to be the most feasible method, although some of this handling is done by means of large open hopper, slow moving Magma pumps of the reciprocating type. To use compressed air the *massecuites* are run into a large closed receiver tank immediately beneath the vacuum pans, and their valves are closed and air applied to the top of the tank. The heavy mass is then forced out of the pipe at the bottom of tank to any point where it is to be delivered.

As each sugar mill has a well equipped machine shop attached, so that repairs can be made in the field to all the machinery in the plant, air tools could be used to a very decided advantage. It is ofttimes necessary to repair a gear which has broken teeth, and this means considerable chipping and fitting. Portable grinders would also be found quite useful.

The cane grinding season covers a period of from 100 to 120 days—sometimes longer—and the operation is practically continuous, 24 hours a day. Therefore, a mill cannot be shut down to await spare parts in case of a break-down, as the financial loss would be quite serious. The repair work is, therefore, performed on the job; and the writer has had occasion to witness patching and repair jobs in sugar mills in Cuba that would have been a credit to our high class machine shops in the States. The millwrights and mechanics around these plants are very resourceful, and, as above mentioned, air tools of the proper kind would no doubt be quite an asset in the machine shop of each sugar mill.

In cleaning the pans and evaporating effects it is oftentimes necessary to chip the hardened scales which form and to clean the tubes in a calendria pan, and an air tool with an auger or a bit is often found to be quite a time saver. You have already published the writer believes, a pamphlet illustrating and describing this method of cleaning.

The vacuum pump, however, is a very important item in a sugar mill. In the early days sugar juices were reduced to syrup and then to grain by boiling in open pans. This was a more or less expensive and tedious method, praticularly as boiling by this method necessarily had to be done under fairly high temperatures, which has a tendency to scorch the juices and carbonize the sugar. The modern method of boiling and evaporation of the water content is done in closed pans or effects, and under vacuum. This naturally allows for the evaporation of these waters at a lower temperature, and pan boiling can be accomplished at temperatures of 160 to 180° F., instead of at, or near, 212°. The barometric type of condenser is most commonly used for condensing the vapors and producing the necessary vacua, and a dry vacuum pump in connection with same is usually furnished to remove the air.

Formerly large crank and fly wheel, steam-driven, reciprocating dry vacuum pumps were used, but since the advent of electric-drive in cane mills, the high-speed, short-belt drive, from motor, vacuum pump is fast replacing the large, slow-moving, cumbersome type of crank and fly wheel vacuum pump, mentioned above. This also is the case in steam-driven machines of this type, as the high speed machine, taking considerably less floor space, is fast gaining preference over the former types.

IN THE BEET SUGAR FIELD

In the beet sugar factories there is at present more general use for compressed air. The beets are conveyed to the factory from the storage and unloading yards by water in open concrete or steel flumes or sluiceways. When the beets reach the factory they must be elevated from 10 to 20 feet to the beet washer. This elevating of the beets is usually accomplished by the use of a "beet wheel," which is provided with elevator buckets on inner rim, and beets flow to these buckets from the above mentioned flumes. This wheel rotates and lifts the beets to the required height and then dumps them into a hopper leading to the beet washer.

A number of beet factories use air for elevating the beets at this point. The Delta Beet Sugar Corporation, at Delta, Utah, is so equipped. The method applied is the regular air lift system, the water and beets flowing to the lift well, where they enter the main air lift pipe and are then elevated to the required height by means of the air system.

The advantage of the air lift system is that the beets are considerably churned about by the air and water and considerable of the washing is accomplished while lifting the beets. Even with the air lift system, however, a beet washer is advisable, as it is very important that all the sand and grit be thoroughly removed before the beets reach the slicing station, so as to prevent breaking of the many delicate knives which do the shredding. The beets cannot receive too careful a washing; hence the extra churning which they receive in the air lift is considered well worth the investment. Simplicity and cleanliness are also quite important items in connection with the air lift system as the beet wheel lift is one of the dirtiest and sloppiest parts of a beet factory.

Compressed air is used, too, in connection with the sulphitation station. Free clean air is compressed and forced through the closed sulphur stoves, forming SO_2 gas, which, in turn, is conveyed to the sulphitation station, which consists of large tanks into which the juice is delivered from the heaters and filter presses after carbonization. The process is simply one of aeration, the gas being blown into the juice at the bottom of the tank and allowed to circulate through it. The object is to clarify and bleach the juice before sending it to the evaporators. Another sulphitation station follows the evaporating effects, in which case the thick juice is treated with SO_2 gas before going through filters and heaters to pan storage tanks and there to vacuum pans, where it is boiled to grain.

Compressed air can also be used for handling the *massecuite,* the same as described under cane sugar factories, when the layout of plant is such that the handling of this mass is necessary.

The CO_2 gas from top of lime kiln, which is used for carbonization purposes in first and second carbonization tanks in same manner as SO_2 gases in sulphitation station, is forced through a CO_2 washer and then into the juice at bottom of carbonization tank by means of reciprocating blowing engines. This gas precipitates considerable tar substance, and, therefore, blowers with fairly heavy and positive valve action are required.

The standard modern high grade air compressor is not suitable for this service on account of the above mentioned tar. I am of the opinion that a small centrifugal blower would work out very successfully on this service, and I found in the course of my investigation and conversations with the practical men around the various beet factories in Colorado and Utah, that they were of the same opinion. The blower could be provided with a tar drain, as the tar would readily run away because of the heat of compression, which would keep the impellers sufficiently warm to keep the tar in a liquid state. The blower capacities should be somewhere in the neighborhood of say 1500 to 2,000 cubic feet maximum, and pressures from 8 to 15 pounds.

Some of the beet sugar factories have installed the Steffens Saccharate Process for reclaiming much of the sugar content still remaining in the molasses. An air compressor or blower is needed in connection with this process in order to blow the powdered quick lime into the diluted molasses.

Air tools of various kinds could be used advantageously around a beet sugar factory, the same as in the case of a cane sugar mill, as described previously. Barometric condensers and vacuum pumps for the evaporators and vacuum pans are also used in most all beet sugar factories. Large vacuum pumps are also needed in connection with the continuous vacuum filters wherever they are used. These are usually installed in connection with the Steffens process.

THE AIR LIFT IN THE BEET SUGAR FACTORY

By G. A. MEYER

THERE are two very good reasons for installing an air lift in a beet sugar factory:

The first one is to lift the beets and the second one is to clean them, cutting down the necessity of using a large beet washer which breaks the beets up badly. The beets at the present time in most of the factories are elevated from the flumes by scrolls or the beet wheel—a wheel from 10 to 30 ft. in diameter with buckets attached. These buckets pick up the beets, water and mud from the flume and lift same into a washer or to higher flume, to save depth as in the case of the Spreckels Sugar Company, where the beet sheds are a thousand feet from the factory. The ordinary flume has 1½ to 2% fall and this in a thousand feet will equal 15 to 20 ft. plus the depth of the flume 4 to 6 ft. This necessitates a beet wheel or an air lift to save depth.

Scrolls are cumbersome and the upkeep is heavy due to the grinding action of the sand in the water. Beet wheels are bulky and cause trouble when they get out of alignment. Therefore the air lift is the logical solution to bring the beets into the factory as there is nothing to wear out being a heavy cast iron pipe set in the casing and if the air compressor is given proper attention the upkeep of this station is only a minimum. The other reason why the air lift should be installed is because of the cleaning action in the U tube, the beets rubbing against each other with a water film between cleans them in better shape than brushing by hand which was an early practice of the European factories before any methods of washing were installed.

After leaving the U tube the beets, mud and stones pass down an elevator flume through a hydraulic rock catcher where the stones, iron (horseshoes, bolts, railroad spikes, etc.), that come in with the beets are separated. They then pass under a trash catcher where leaves, wood and other floating material are taken out and then passed over a grizzly where the dirt and water flow to the sewer and the beets fall into a washer where they are rinsed before elevating. The washer can really be dispensed with as the beets are thoroughly clean and the only reason that they pass through this washer is that they have been installed before the air lift was thought of.

One will find, in talking over this subject with executives and engineers of some of the sugar factories who know the air lift by name only, that they will say that when the beets pass through the U tube it will break them up. This is not the case. Taking for example: a factory slicing one thousand tons of beets per day which is approximately 1500 lbs. per min.; these beets are floated with 2500 gallons of water per min., or 20,000 pounds of water per min., that is, one of beets to 14 of water. There is no breaking up of the beets in this case. The paddles of the beet washer do much more damage than the air lift. You will find where the air lift has been installed that the customer will not revert back to the scroll or the beet wheel being thoroughly satisfied with the performance of this installation.

The reason why no more lifts are installed is first the initial cost of the compressor principally, and the second sugar factory executives as a rule have not been educated to the use of compressed air and are under the impression that it will take higher skilled labor to operate such an installation. This is not the case.

If the safety valve is set with the pressure to correspond to the lift it is very simple indeed to operate. These are the comments that one hears in going around to the different factories where the air lift has not been installed.

The following factories have air lift systems installed by the Stearns-Roger Mfg. Co., Denver, Colo.

American Beet Sugar Co., Oxnard, Calif., two 2,000-ton lifts per 24 hrs.

Michigan Sugar Co., Alma, Bay City, Croswell & Saginaw, one 1,500-ton lift per 24 hrs.

West Bay City Sugar Co., West Bay City, one 1,000-ton lift per 24 hrs.

Columbia Sugar Co., Salzburg, Mich., one 1,300-ton lift per 24 hrs.

Columbia Sugar Co., Paulding O., one 1,000-ton lift per 24 hrs.

Great Western Sugar Co., Bayard, Neb., one 1,500-ton lift per 24 hrs.

Delta Beet Sugar Co., Delta, Utah, a double lift, 1,400 tons per 24 hrs.

It will be noted from these installations that the sugar companies are gradually installing air lifts.

EXPERIMENTS TO OVERCOME AIR-BRAKE LEAKS

Results of tests and numerous opinions as to the cause of excessive leakage in the auxiliary devices of the locomotive air-brake system and the method that should be used to overcome it were presented at the twenty-sixth annual convention of the Air Brake Association, held at Chicago in May.

The Committee on Air Consumption of Locomotive Auxiliary Devices entrusted with this investigation performed both standing and running tests. It is related in *Mechanical Engineering* that the standing tests were made on locomotives in roundhouses, and consisted in measuring the amount of air used by the auxiliary devices operated while the locomotives were standing.

The running tests were made on freight engines working over the road in service, and consisted of the continuous measurement of air used by the auxiliary devices in operation while the engine was running. A total of 489 individual tests were classified and arranged in the report submitted by the committee.

A summary of their principal results is as follows.

1 Auxiliary devices under average conditions were found to use too much air.

2 Conditions frequently exist where compressor capacity may be exceeded by the demands of the auxiliary devices.

3 Some of the data justify the conclusion that auxiliary devices should be operated separately from the air-brake system. On the other hand, some of the data show that with proper maintenance this conclusion might not be warranted.

4 Under some conditions it would not be satisfactory to connect the auxiliary devices to the air-brake system and increase the compressor capacity accordingly, unless the air-brake main reservoir were protected from the consequences of excessive air requirement by the auxiliary devices.

5 Cost-basis data show that better maintenance would be profitable.

6 Standards of performance, including maximum permissible leakage, should be established.

7 Means should be devised for checking and testing the performance of auxiliary devices.

The committee did not consider their work as complete and recommended that their data be further increased by investigations on individual railroads. They concluded by advocating the plan of operating the auxiliary devices at a pressure lower than that carried in the air-brake system main reservoir.

This plan would effect a large saving in air used, but would require a separate air supply reservoir with means provided for controlling the reduced pressure.

The Allied Machinery Co. of America recently increased its capital stock to $5,000,000. This was made necessary by the decision of the American International Corporation to group all of its machinery export selling subsidiaries under one head, completely absorbing the Allied Construction Machinery Corporation. The Allied Machinery Co. de France, the Allied Machinery Co. d'Italia and the Horne Co., Ltd., of Japan, while retaining their corporate entities, will also be directly connected with the Allied Machinery Co. of America, rather than the American International Corporation, as before. The Allied Machinery Co. of America is at present operating in 14 countries. J. W. Hook will continue as president. F. A. Monroe, in charge of administrative affairs, S. T. Henry, in charge of sales and advertising, and T. G. Nee, devoting his attention to the affairs of the Horne Co., Ltd., have been elected vice-presidents. R. P. Redier is general sales manager of the company, with headquarters in Paris.

A pasty material, with acid characteristics, which is suitable for soap making, has been produced from Galician petroleum. The process of conversion consisted in subjecting the petroleum to a current of air at a temperature of 130 to 135 deg. Cent. for two or three weeks.

Air Equipment at the Railroad Convention

By FRANCIS JUDSON TIETSORT

THE ANNUAL convention of the Mechanical Section, No. 3, of the American Railroad Association (comprising the consolidation ordered by the Director General of the U. S. Railroad Administration, of the Master Car Builders' Association and the Master Mechanics' Association) was held at Atlantic City recently and it proved one of the most absorbing interest to thousands. The Railway Supply Manufacturers' Association, which administered the exhibits and entertainment provided for the dual sessions during the week of June 18-25, and which held its own annual meeting at the time, was unusually successful in arranging for this year the largest and most complete exposition of railway apparatus and appliances in the annals of American railroading.

In the matters of exhibits, enthusiasm, attendance and real helpfulness, it is doubtful whether the 1919 convention has ever had a parallel. A throng of delegates, their guests and lay visitors were attracted from all parts of the United States, and from a number of foreign countries, to hear the papers and business discussions and to inspect both the indoor exhibits housed on the "Million Dollar Pier" and the outdoor track exhibits. They also enjoyed the concerts, the dances, and the speeches of celebrities, not to mention the incidental pleasures one associates with America's most famous seaside resort.

The exhibits of the supply companies numbered 301 this year and occupied 93,500 square feet of floor space on the Young's Pier, this exceeding the record exhibits of 1913 considerably. In that year there were 277 displays occupying some 87,360 square feet.

Among noteworthy exhibits this year were large installations of heavy machinery such as lathes and machine tools, all under power and in actual operation. From this fact alone the educational value of the exhibits may be guaged. The Niles-Bement-Pond Company of New York included in its exhibit a tiny moving picture theatre.

The track exhibits numbered some extraordinary details, such as the mammouth hopper and gondola cars of more than 100 tons capacity, for mineral traffic, shown by the Pennsylvania Railroad. In mentionnig this fact it is worthy of note that the Woodward Iron Co. built and put into service in 1916 the first 100-ton car. The Virginia Railway has built since then four 120-ton experimental cars and the Norfolk & Western has built both hopper and gondola cars of 180,000 lb. capacity. All these cars are on six-wheel trucks.

Another track exhibit to hold the eye was that of a U. S. Navy 14-inch gun mount, on forty wheels, built by the Baldwin Locomotive Works, Philadelphia. This great rifle, with a range of forty miles or more, was finished and delivered at Atlantic City only the day before the conventions opened, and was in charge of Navy officers. Except for a few minor refinements and changes, they told one, this gun mount was a duplicate of the five big Navy gun mounts which were sent into action in France against the Germans, with such terrifying results for the enemy. This gun employs compressed air at 150-lb. pressure for its operation and for the ejection of gases after discharge.

There was also a display of some new United States Army railway artillery, built by the American Car & Foundry Co. of Detroit, and shown by courtesy of the Ordnance Dept. One twelve-inch rifle was a wicked looking engine of death, and in addition there was a big mortar, besides some rifled guns of lesser calibre. Thousands viewed these specimens of modern American heavy artillery, which can travel on wheels in a hurry almost anywhere to defend a threatened position.

The compressed air, pneumatic tool and other pneumatic device features of the pier exhibits, which were our especial interest, were varied and received careful attention from the delegates. The leading American houses in the field all had comprehensive showings, with scores of able representatives on hand to demonstrate their products to users. This was justified, inasmuch as the great railway systems of the country are probably the greatest users of compressed air equipment, and have been more largely instrumental in the development of pneumatic equipment, through the original impetus of the air brake, than have any other adapters of compressed air as a useful force.

Showings of exceptional interest were those of the Ingersoll-Rand Co., of New York, displaying the Little David type of pneumatic tools, etc.; the Chicago Pneumatic Tool Co., Chicago, with Boyer pneumatic hammers and the Little Giant line; Independent Pneumatic Tool Co., Chicago, with piston air tools, pneumatic grinders, pneumatic tool hose couplings, etc.; Keller Pneumatic

Tool Co., Grand Haven, Mich., with pneumatic hammers, rammers, pneumatic tool safety devices, etc.; Duntley-Dayton Co., Chicago, with pneumatic tools; the Westinghouse Air Brake Co., Pittsburgh, and the General Electric Co.

There were dozens of exhibits of train pipe connectors, air brake guages, air valves, air hose and piping, packing for air pumps and compressors, air-operated arch tube cleaners, air brake devices, hydro-pneumatic pit jacks, hydro-pneumatic accumulators, pneumatic flanging machines, and other appliances in the air field. The number of air and pneumatic products shown, and the absence of many that are in such universal use, raised the question in the minds of air specialists whether there ought not to be an annual "air show."

Air figured to a considerable extent in the outdoor track exhibits of locomotives. One machine was that of the Westinghouse Electric & Manufacturing Co., which displayed the most powerful electrical locomotive in the world, designed for freight use of the Pennsylvania, having 140,000 pounds starting tractive effort and 87,200 pounds working tractive effort, and giving 48,000 h.p. at 20.6 miles per hour. This machine has twelve drivers. Electric-driven fan blowers give low air compression for ventilating the motors.

The giant steam locomotive, No. 3700, built at the Juniata shops, near Altoona, by the Pennsylvania, and undoubtedly the biggest and most powerful steam locomotive ever designed and put together, was the most talked about exhibit at the conventions. This Mallet type is really a double locomotive, or two in one. It is so big in appearance (105 feet in length over all, including tender) that one's first impulse on seeing it is to stop and gaze in amazement. It is equipped with two sets of driving wheels, sixteen in all, each 62 inches in diameter. This machine weighs 550,000 lbs. and has a tractive power of 130,000 lbs. The cylinders are 30½ inches by 32 inches and the working boiler pressure is 225 lb.

A remarkable feature is its equipment with the new Duplex Mechanical Stoker made by the Locomotive Stoker Co. of Pittsburgh. The fire box is twenty feet long and only one fireman is required to feed the monster. The coal passes through a gyrolating crusher and is distributed over the surface of the firebox by compressed air. The total heating surface, including that of superheater, is 13,360 square feet.

Compressed air is also used to operate the water scoop beneath the engine, which takes its water feed from the track troughs as do passenger locomotives. There are superior provisions for new Westinghouse air brake equipment on this colossus of the rails. The two big air pumps are located forward of the boiler, high above the pilot, an unusual location for such equipment. The engine is to be used in mountain climbing around Altoona and it was declared at the convention that it would pull a loaded freight-train a mile long up a very stiff grade at from twenty to thirty miles an hour. The tender carries 13,000 gallons of water and 30,000 lbs. of coal.

Oil of good quality and in considerable quantity has been struck in England for the first time. The discovery is due to the initiative of Lord Cowdray, formerly known as an engineer by his name of Sir Weetman Pearson. He built the Tehuantepec railroad across Mexico and is now identified with big oil interests in the Tampico field. On May 27 at a depth of 3000 feet in Derbyshire a well was 'brought in,' the oil rising in the bore to 400 feet. This work, which is being backed by the British government, is the direct result of geologic deductions, supplemented by experience on other oil-fields. It is a highly interesting development, largely because it represents the application of scientific reasoning to industrial enterprise.

The Pennsylvania Railroad System employs 33,000 men of foreign birth, of whom nearly one-third are Italians. To make them more efficient the company has established a correspondence course in Italian-English, in charge of an Italian graduate of Yale. Stereopticon lectures are given and eleven pamphlets are issued, instructing the men in the use of tools and in the fundamentals of safety, health and sanitation and to raise their standard of living. One pamphlet is devoted to the use of tools, another to signals, and one to good citizenship.

Government restrictions on the export of vegetable oils, coupled with what is apparently an over-production of oil, the result of the stimulus of war-time conditions and prices, has resulted in the production of a paradoxical condition in the industries producing or handling vegetable oils. While there is a strong demand for fats of all kinds over wide areas in Europe, with good prices offering, the American market is glutted with vegetable oils. Not only is this condition of affairs causing American dealers and manufacturers a great deal of inconvenience, but the holders of large stocks of raw and refined oils are threatened, if the present condition of affairs continues for any length of time, with serious losses through the deterioration of the oil.

What About Our Merchant Marine?

By EDWARD N. HURLEY

[Chairman United States Shipping Board]

EDITOR'S NOTE—*Chairman Hurley aroused great enthusiasm several weeks after the subjoined article was written, by announcing at the Pan-American Commercial Congress in Washington that in November the United States Government would begin a fast passenger and freight service to Rio de Janeiro and Buenos Aires with the three superb ships, the MT. VERNON, the AGAMEMNON, and the VON STEUBEN, formerly crack German liners, making 23 1-2 knots per hour. These vessels will traverse the route to Rio in ten days and to the River Plate metropolis in fourteen days. Best time made previously by English ships from New York was 17 days to Rio and 24 days to Buenos Aires, including stops. The new service will save a month's time on the round trip and will be the greatest stride made by any nation in its commercial and social relations with the South American republics.*

The new steamship service will have a great significance for American industry, an effect that can be guaged accurately only by those Americans who have lived in the great East Coast ports of Latin America.. It means that many thousands of wide-awake Americans will flock to cities like Rio de Janeiro, Sao Paulo, Montevideo, Buenos Aires and Rosario, that our commercial and social relations with the republics to the South will be much extended, and that, taken in conjunction with the new and direct cable service to be established by the Western Union Telegraph Company via Miami, Fla., Barbados and Para, and thence down the coast to Pernambuco, Bahia and Rio, that the United States will be placed in a pre-eminently favored position. Mr. Hurley's announcement was, for American manufacturers and exporters, the biggest piece of news of its kind in a generation.

Our shipping service generally to South American countries on both coasts is so to be improved that it will surpass any of the European services before the war. A total of 226 ships of 863,334 dead-weight tons have been allocated to Latin-American trade. Two new lines to serve the eastern and western sections of the West Indies are also to be established. There is projected, too, an air mail service from Boston, New York and Philadelphia to Panama, via Florida and Cuba, which will later be extended to comparatively inaccessible places in northern South America.

THE TRANSPORTATION question, both on land and on sea, is most vital to the future of our country. Our overseas trade which we have endeavored to develop the last few years must be expanded along sound business lines, and the first step is a permanent, efficient American merchant marine. If our ships are not operated efficiently, it will mean high freight rates for our farm products and manufactured articles. With an even start in the race as regards the cost of our ships as compared with foreign ships, we can not continue to compete and have reasonable freight rates unless the ships are operated efficiently.

We all have different points of view. The shipper wants reasonable freight rates. The carrier wants reasonable earnings. These two objectives are not inconsistent. Efficient operation can achieve them both.

Many of us are in favor of private ownership and operation, feeling that the ships can be more efficiently managed in this way than by Government ownership. Others are disposed to favor chartering for a period of years. Still others are sympathetic towards Government ownership.

There is no question that if the Government sells these ships to private operators an equitable distribution should be made so that the respective sections of the country will be able to own and operate these ships out of their respective ports.

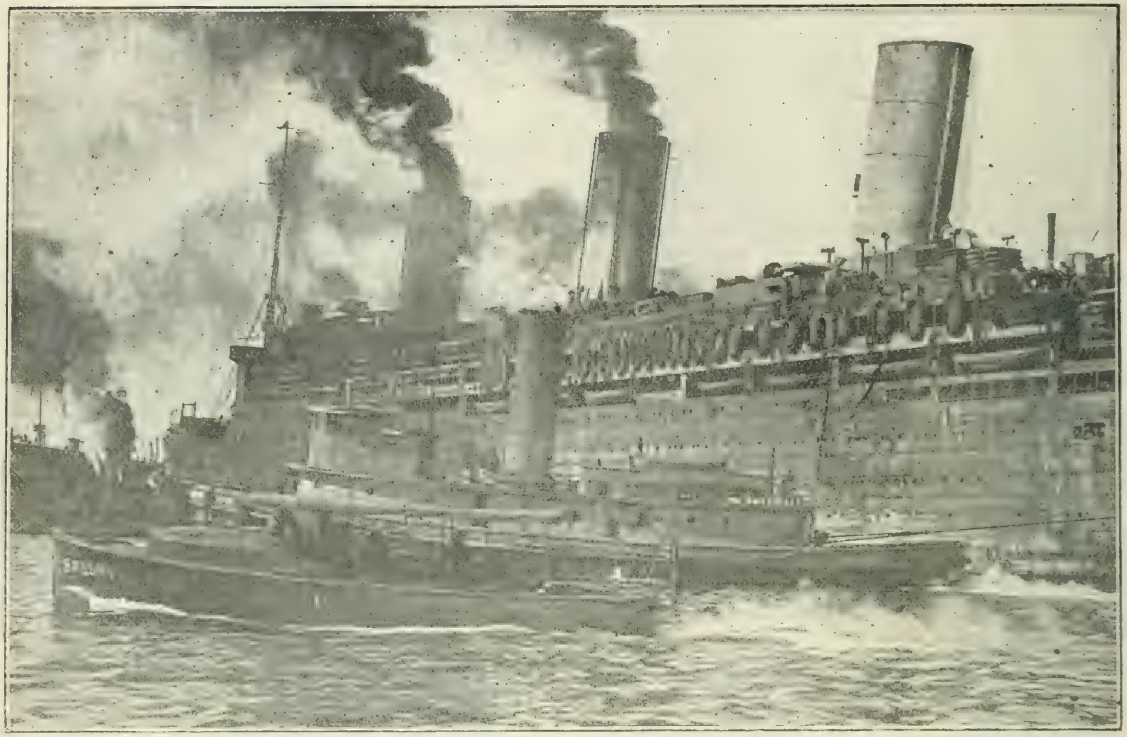
The ports of Wilmington, Savannah, Charleston, Brunswick, Jacksonville, Pensacola, Mobile, New Orleans, Galveston, Port Arthur, Los Angeles, San Francisco, Portland and Seattle have developed wonderfully in the last few years in the production of products for export, and arrangements must be made whereby each section of the country will have every opportunity to establish through steamship lines in connection with its railroads so that every community may receive first-class service.

These ports are improving their terminal facilities, and when these improvements are made, not only will American ships be carrying cargo overseas and return imports from other countries, but foreign ships will be entering these ports for the cargoes they require.

The great ports of Norfolk, Baltimore, Philadelphia, New York, Portland and Boston are also capable of taking care of a larger amount of additional tonnage and the efficiency of these ports with their modern methods for the quick turnaround of ships has been most helpful.

Fifty per cent. of our commerce should be carried in American bottoms, and the other fifty per cent. should be carried by the ships of other nations. If we planned to carry more than fifty per cent., it would be necessary for many of our ships to return in ballast, and, therefore, we could not hope to have low freight rates.

I do not propose in this article to touch upon the question of how the Government should dispose of these ships. However, I feel that I should



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THE LEVIATHAN, THE GREATEST STEAMSHIP AFLOAT, HENCEFORTH TO FLY THE STARS AND STRIPES AS A PART OF THE AMERICAN MERCHANT MARINE. SHIPS OF THIS CLASS WILL BE UTILIZED TO CARRY THE UNITED STATES MAILS UNDER THE NEW ARRANGEMENTS CONTEMPLATED AND DESCRIBED BY MR. HURLEY IN HIS INTERESTING ARTICLE, INSTEAD OF PEDDLING OUT THIS MAIL TRANSPORTATION TO UNWILLING FOREIGN SHIPS.

outline three great national needs which our merchant fleet should be designed to fill in addition to the freight carriage which is its primary function. They are:

(1) The establishment and maintenance of an American ocean mail service capable of covering the world.

(2) A centrally-controlled wireless telegraph service for use in promoting the safety of life and property at sea, and for giving to American shipping and business the advantage of constant commercial information.

(3) Adequate provision for the training of an *officer personnel* capable of making sure that our ships will always *go to sea* in charge of American citizens.

The importance of an American overseas mail service hardly can be overestimated. In the creation and transaction of overseas business it is second in importance only to the ships themselves. We never have had an American overseas mail service. In the trans-Atlantic mail service we never have had more than one American sailing a week, and we are, therefore, dependent upon foreign ships which, I have been informed, have refused at times to carry our mail.

In the South American mail service foreign steamships always have carried all the mail from New York to Venezuela, the Amazon, Rio de Janeiro and Buenos Aires. In many cases this mail did not even go direct, but was taken 3,200 miles out of its way and delayed ten days going by way of England.

The Shipping Board is beginning to correct this condition insofar as it lies in our power to do so. But, unfortunately, this trouble is fundamental, moored hard and fast by the precedents of half a century; and it cannot be corrected merely by assigning a few American vessels to certain mail routes. We must discard our present laws and customs, and we must build anew on sound foundations and business principles.

The idea that mail must be carried *only in fast passenger vessels is fallacious.* If we had daily, or even odd-day, sailings of such vessels, no doubt the mail should go in them. But we have not a sufficient number of such vessels to make daily or odd-day sailings, and the needs of our trade do not call for any such number of them. We ought to send our mail by the twelve and fourteen-knot freight liners as well as by the eighteen and twenty-knot passenger liners. Then we could count on frequent sailings in every trade route, and the service would average better, both in time and reliability, than any service we have ever gotten from foreign steamship companies. Then, too, there is a certain psychological factor which should not be ignored. It would look more business-like to have the American mails arrive in the ships which bring American goods.

We handle our domestic mails on a business basis, and we should do the same thing with our overseas mail. We pay the railroads, the railway mail clerks, the postmasters, the postoffice clerks and the city and rural letter carriers fair fees and salaries for public service rendered. We do not ask the citizen who passes through a given street morning and evening to deliver the mail to his neighbors whenever he feels like earning so many cents a pound for all the mail he so delivers.

Yet this is exactly the basis on which we are now trifling with such an important branch of the public service as our overseas mail. The chief reason why *we get any ocean mail service at all* is because a ship happens to be making the voyage anyway, and might as well take a few sacks of mail along *as not.* The present ocean mail fee is only eighty cents a pound for letters and four cents a pound for printed matter—hardly a business proposition or a fair return for service rendered in most trade routes.

We should change all this. We have a law which permits us to pay $8 a mile on the outward voyage to vessels carrying the mail at a speed of 35 knots an hour, and $4 a mile to vessels making 20 knots. This law as it applies to the 35-knot ship is doing us no good because we have no such vessels, and the needs of our trade probably never will require a sufficient number of them to handle all our overseas mail.

We could establish *at once* a real American ocean mail service which would efficiently serve American trade if we could change this law so as to bring it down from the realm of impracticability and make it apply to the seagoing units which we actually possess, and of which we expect the bulk of our future fleet will be composed.

It would be well to reduce the $8 rate to $6 and make it apply to 20-knot vessels because we expect to have some liners making 20 or 25 knots. We need not seriously consider the 35-knot ship in our general ocean mail scheme for two reasons: First, the number of them always will be small; and second, the superiority of their total service over that rendered by all the 20- and 25-knot ships would not seem to warrant the extra payment of $2 a mile. Any such payment not rigorously based upon service rendered would be open to the appellation "subsidy"—a thing to which many of us are unalterably opposed on principle.

If the $6 rate were paid to 20-knot ships; the $4 rate to 14-knot ships; and the $2 rate to 12-knot ships, I firmly believe we would have an efficient American ocean mail service capable of covering the world, and of placing every American farmer, manufacturer and merchant in direct touch with each and every one of his foreign customers. We will all readily admit that the money value of such a service to the American people would be difficult to overestimate.

Simultaneously with the establishment of a general ocean mail service on business principles, we should include an overseas extension of the parcels post. Properly carried out on a larger scale it would require the presence on each mail ship of a duly appointed United States overseas mail officer to look out for parcel post packages and the mail. These duties could be conveniently combined with those of the supercargo, who is the business man on all Government ships in charge of the cargo abroad, and who at present is also performing excellent service as the trade scout of American industry.

Regarding the presence of a wireless telegraph set on board each vessel flying the American flag, I need not add to what I already have said. There is no question, however, that the wireless should be navy-manned under navy control for three reasons:

First, it would render more efficient the use of the wireless for the protection of life and property at sea.

Second, it would enable our merchant ships to communicate information to each other and to their home offices.

Third, this control would make easy the instant mobilization and protection of the whole fleet in case of war.

Lastly, I wish to lay before you the necessity for using our fleet for training American citizens to be its future officers. This matter is so vital to the public interest that the Government should undertake to supervise and finance it.

Deck and engineer cadets should be carried in all vessels, three or four in small cargo steamers and six or eight in large liners. They should be selected from the rank and file of the boys who elect to follow the sea, perhaps by competitive examinations held by the steamboat inspectors at the custom houses under the direction of the Civil Service Commission.

The cadets should be paid $50 a month the first year and $70 a month the second year. The officers of the ships should be required to give them professional schooling and the Government should pay the private steamship company $25 a month for the tuition of each cadet, in addition to $15 a month for maintenance. If it is worth while to pay $50,000 to train a naval officer, does it not seem equally in the public interest to spend, say, $2,400 a man for the creation of an American personnel to command the fleet with which we expect to keep the American flag on the seas?

These are matters which bear directly upon the usefulness of the merchant marine to the American people, no matter who owns the ships or who operates them, and as such they cannot fail to help keep us mindful of the vital national importance of this subject.

Mr. Rosseter's Views

In a recent letter to Mr. Hurley, written by the Director of the Division of Operations of the Shipping Board, Mr. J. H. Rosseter, who has had thirty years' practical experience with shipping affairs, expresses views that are of the utmost interest and importance to Americans as regards the successful operation of ships under the American flag in foreign trade. Mr. Hurley has written the editors of COMPRESSED AIR MAGAZINE enclosing a copy of Mr. Rosseter's letter, from which we herewith present excerpts:

I wish to state with utmost emphasis and firm conviction that there are no insuperable obstacles to our success in competition with other nations. Against this you hear men of experience in shipping assert with equal emphasis that our disabilities, particularly the higher cost of manning, are such as to place American ships at a hopeless disadvantage. Such adverse statements, given wide publicity, naturally confuse the public mind, causing a feeling of uncertainty and hesitation very prejudicial to our aspirations.

As often happens in large questions, the controlling factors are overlooked or neglected. The amount of wages paid is to be properly measured by accomplishment. It is true we have a larger number of officers and men on a ship than required under foreign flags, and that we pay higher wages and provide better food, all of which cost more than our competitors are paying. That is not to be contradicted and for my part it is not to be changed, confidently expecting, as my own experience has proven, that we get better and more efficient service from men who are well paid and well fed.

We also suffer extra cost as a result of stupid and needless regulations in the form of tonnage measurements, etc., which should, and undoubtedly will, be corrected.

Much emphasis has been laid on these items and too little attention given to the really important problems. Within our reach are advantages to be gained, far offsetting our disadvantages, and I confidently believe that American ingenuity when properly directed will triumph. As an example, consider the cost of water-borne commerce on the Great Lakes. There you find, under the spur of necessity and achievement, that American built and American manned ships are handling and carrying cargo at the lowest cost per ton known in world's commerce. It is but a step to the equal accomplishment in our ocean business but we must approach the problem with confidence and determination.

The prejudice of higher costs of manning, by which I mean larger crews at higher pay and extra cost of victualling, can be fairly stated as amounting to less than two per cent. of the total operating expense. This can be entirely offset, and more, by a reasonable increase in the speed of our ships and by improving loading and discharging equipment, thus reducing the time in port as well as on voyage.

Again there is the problem of improving the method of propulsion by utilizing the great natural advantage we hold in our supply of oil fuel. As you know, even with the ordinary reciprocating type of engine we get one-third greater distance from a ton of oil than from a ton of coal, besides doing away with the so-called "black squad," which means a reduction of at least six men in the engine room. So great are the possibilities in the field of propulsion that I will not venture even a surmise as to what may be accomplished in that respect.

Other questions which have a most important bearing on our maritime enterprise may be briefly mentioned:

(a) Cost and type of construction, in which we should lead the world;
(b) Utilization of natural highways and channels of trade, including co-ordination of railways and steamship lines;
(c) Development of efficient maritime organizations abroad as well as at home. Without proper representation and facilities abroad we would be at a fatal disadvantage;
(d) Assurance to shipowners and merchants of the lowest rates of marine insurance;
(e) The most favorable facilities for foreign exchange and discounts;
(f) Such conservation or legislation as may be necessary to assure a supply of oil fuel for our ships.

These are the real problems we are facing, and confident of a successful solution I believe firmly that we will reach a high place in world's commerce.

The prize is a great one. Aside from feelings of national pride and considerations of national security, our merchant marine will bring, in increased revenue, more than $500,000,000 a year to our national resources, which is a very moderate estimate, taking but small account of the great increase in trade.

The following working schedule has recently been adopted at the works of James Walker & Co., Limited, London: Monday, 8 a. m. to 5.30 p. m.; Tuesday, 7 a. m. to 5.30 p. m.; Wednesday, 7 a. m. to 5.30 p. m.; Thursday, 7 a. m. to 5.30 p. m.; Friday, 7 a. m. to 6 p. m.; Saturday, works closed; mealtime break, 12 to 1. Special attention is called to the fact that the works are closed on Saturday, which is a whole holiday for everyone.

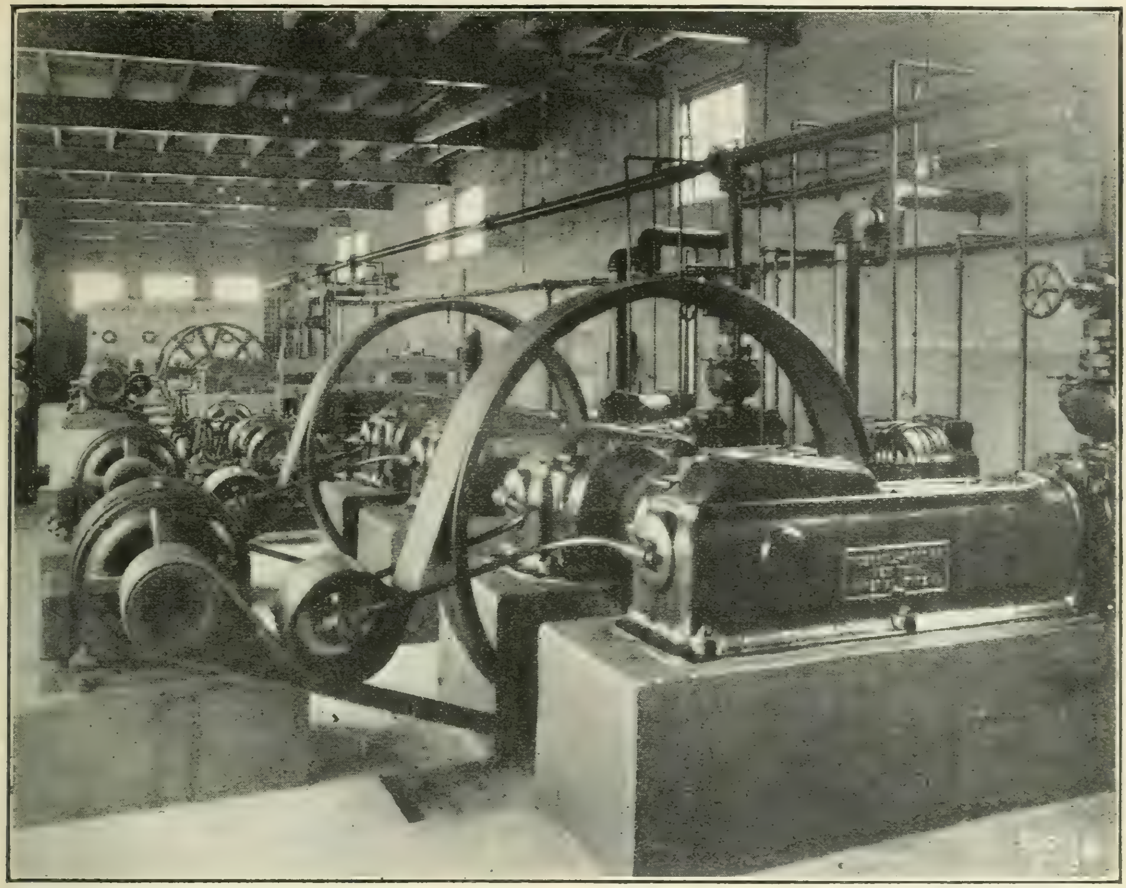

Photo by courtesy of the Ingersoll-Rand Co.

FIG. 1. POWER HOUSE WITH FOUR COMPRESSORS.

Highly Efficient Air Lift Installation with Special Features at Fort Bliss, Texas

By *CAPTAIN J. F. BROWN**

CAREFUL analyses of conditions to be met and thorough study of air lifts in successful operation have made possible the design and installation of such a plant at Fort Bliss, Texas, tests of which show operating efficiencies never before attained—51.9% as the average of the better of two sets of air lift tests, and 28.66% as the corresponding over all or wire-to-water efficiency.

The footpiece, Fig. 2, consisting of a double conical bronze casting (inverted at lower end), set within and at the foot of the eduction pipe, is the special feature of design. Particular attention was also given to the proportions of the eduction pipe and to the head tanks at the top of each eduction column. Small water storage reservoirs, with sand settling compartments and measuring wires, are provided.

Water for all needs of the permanent military establishment, as well as for several bodies of troops encamped temporarily on the Fort Bliss military reservation, is supplied from four bored wells, each 600 ft. deep, and is pumped from these wells into surface reservoirs by means of compressed air. From the surface reservoirs the

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*Quartermaster Corps, Engineering Branch, Construction Division of the Army, Kansas City, Mo. Condensed from *Engineering News Record*, June 5, 1919, with additional data and illustration interpolated.

water is pumped directly into the distributing mains by centrifugal pumps.

These wells, two of which are 10 in. and the other two 12 in. in diameter, are cased to the full depth with standard threaded steel casing. From the normal water plane to the bottom the casings are perforated with ½ x 10 in. vertical slots, the area of opening being 10 sq. in. per foot of casing. In the 10 in. wells drilled in 1913 the slots were cut by means of air operated hammers, while in the larger wells, drilled in 1917, they were cut by an oxyacetylene torch. The latter method proved to be much more rapid and less costly than the former.

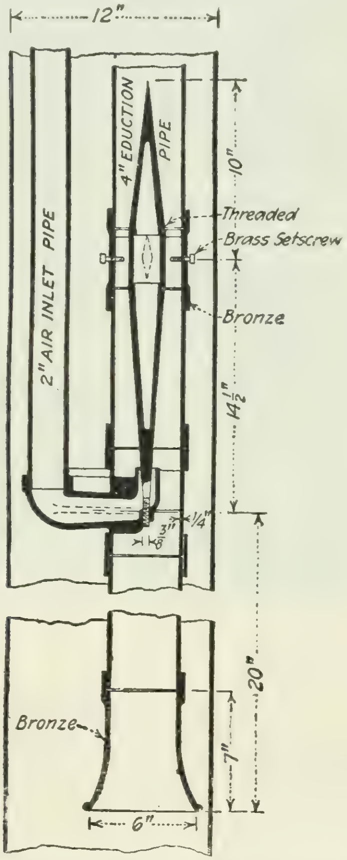

FIG. 2. AIR LIFT FOOT PIECE.

Following are the piping details of the several wells:

WELL NO. 1

Diameter 10 in.
Total depth 615 ft.

Water Discharge Piping

4 in. dia. 20 ft. below foot piece.
1 ft. 4 in. length of foot piece.

Piping Above Foot Piece

4 in. dia. 100 ft. 3 in.
4½ in. dia. 160 ft. 0 in.
5 in. dia. 253 ft. 5 in.
6 ft. dia. 23 ft. 3 in.

536 ft. total distance from foot piece to separator tank above the ground.

WELL NO. 2

Diameter 10 in.
Total depth 615 ft.

Water Discharge Piping

4 in. dia. 20 ft. 3 in. below foot piece.
1 ft. 4 in. length of foot piece.

Piping Above Foot Piece

4 in. dia. 106 ft. 1 in.
4½ in. dia. 160 ft. 4 in.
5 in. dia. 274 ft. 7 in.
6 in. dia. 11 ft. 0 in.

553 ft. 4 in. total distance from foot piece to separator tank above the ground.

WELL NO. 3

Diameter 12 in.
Total depth 615 ft.

Water Discharge Piping

4 in. dia. 21 ft. below foot piece.
1 ft. 4 in. length of foot piece.

Piping Above Foot Piece

4 in. dia. 146 ft. 4 in.
4½ in. dia. 169 ft. 9½ in.
5 in. dia. 92 ft. 6 in.
6 in. dia. 81 ft. 5 in.
7 in. dia. 61 ft. 5½ in.

552 ft. 8 in. total distance from foot piece to separator tank above the ground.

WELL NO. 4

Diameter 12 in.
Total depth 615 ft.

Water Discharge Piping.

4 in. dia. 20 ft. below foot piece.
1 ft. 4 in. length of foot piece.

Piping Above Foot Piece

4 in. dia. 157 ft. 8 in.
4½ in. dia. 162 ft. 8½ in.
5 in. dia. 92 ft. 7 in.
6 in. dia. 104 ft. 6½ in.
7 in. dia. 40 ft. 9 in.

558 ft. total distance from foot piece to separator tank above the ground.

222 ft. depth to water level when not pumping.

234 ft. depth to water level when pumping.

135 lb. gage, air pressure, starting.

130 lb. gage, air pressure, running.

Air for operating the four wells is supplied by four Ingersoll-Rand duplex two-stage compressors, two of which are equipped with high and low-pressure cylinders 7½ in. and 14 in. dia., respectively, the other two having cylinders 7 in. and 12 in., and all having a 12 in. stroke. At the normal speed of 190 r.p.m. the two larger compressors deliver 320 cu. ft per min. each, and the smaller 260 cu. ft. each, operating against a terminal pressure of about 150 lb.

All of the compressors discharge into a 6 in. header, at each end of which is an air receiver 3½ ft. dia. and 10 ft. long. From each receiver compressed air is distributed to two wells, the air supply line to each well being 3 in. At the well head the air line is reduced to 2 in. and extends into the well between the casing and the eduction column to a depth of approximately 540 ft., at each point it connects into a specially designed bronze foot piece.

The function of the foot piece, Fig. 2, is to facilitate the thorough mixing of the current of air and the rising column of water. This highly important feature of the installation differs radically from the well known commercial types of foot pieces. It consists essentially of a double conical bronze casting supported concentrically within the eduction column, the apex of the lower cone extending just into the compressed air inlet. From this point the velocity of the rising column of water is increased, due to the decreased area of the section, until the throat section at the base of the cone is reached, at which point the velocities of the two currents are very nearly equal. In this portion of the foot piece there occurs the thorough mixing of air and water, the two fluids passing through the throat section in a thin sheet or film. The upper cone serves to provide a steadily increasing section, thus preventing a separation of air and water which would be caused by the shock due to a suddenly increasing section. The eduction column was designed of such proportions that the maximum velocity of the rising column of water and air should not exceed 25 ft. per second at any point when the well was delivering at the normal rate, and increases in diameter from 4 in. at the foot piece to 7 in. at the top.

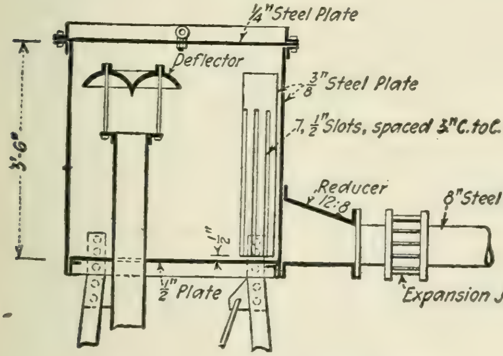

FIG. 3. AIR LIFT HEAD TANK.

At the upper end of each eduction column is a cylindrical steel head tank, Fig. 3, 3½ ft. in diameter and 3½ ft. in depth, within which is supported, just above the end of the pipe, an umbrella-shaped cast-iron deflecting vane, whose function is to break the force of the rising column of water and air. The head tanks are closed at their tops by means of steel plates, bolted on over rubber gaskets to prevent the escape of air. From the head tanks water and air flow through 8-in. galvanized-steel pipe lines supported on angle-iron frames and concrete piers, to two covered rectangular reinforced-concrete reservoirs of 46,000 gal. capacity each. Each reservoir contains a small settling chamber, in which the sand coming from the wells subsides, and a rectangular weir for measuring the rate of discharge from the wells. Fig. 4.

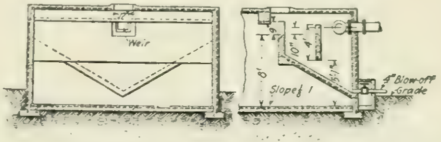

FIG. 4. RESERVOIR WITH SAND SETTLING COMPARTMENT AND WEIR.

Horizontal, double-suction, single-stage, volute-type, centrifugal pumps are used for pumping the water from the surface reservoirs into the distributing mains. There are four of these pumps, each rated to discharge 600 gal. per minute against a head of 135 ft. at a speed of 1760 r.p.m., although two of them have a discharging rate of about 1000 gal. per minute when operating against that head.

All of the compressors and centrifugal pumps are driven by constant-speed, induction-type motors. The motors for the two larger compressors are rated at 75 hp. each and operate at a speed of 580 r.p.m., while those for the two smaller compressors are rated at 61 hp. each and operate at a constant speed of 1150 r.p.m. Each centrifugal pump is direct-connected by means of a flexible coupling to a 40-hp. motor, which operates at a constant speed of 1760 r.p.m.

Upon completion of the original installation, consisting of the two larger compressors and two centrifugal pumps, a series of tests, or trial runs, was made to ascertain the efficiency of operation of the plant, particularly of that portion of the plant used for lifting water from the wells. During the past year the capacity of the plant has been practically doubled by the installation of additional compressors and pumps, and upon completion of this work a second and more comprehensive series of tests was made.

Test No.	Actual Air Delivered Cu.Ft per Minute	Water Delivered per Minute		Air Pressure at Receiver, Lb.	Pumping Head, Ft.	Water, Hp	Air Hp. Iso-thermal	Input to Motors, Hp.	Efficiency, %		Units Operating	
		Gal.	Cu.Ft.						Air-Lift	Overall Wire-to-Water	Compressors	Wells
			I. Input to motors from readings of watt-hour meters. Output from wells from weirs									
2	468.5	554	74.1	133	239	33.6	68.9	130.1	48.7	25.8	3 and 4	2 and 3
3	473.9	566	75.7	133	239	34.3	69.7	127.4	49.2	26.9	3 and 4	2 and 3
6	521.4	614	82.1	132	239	35.6	76.6	153.0	46.4	23.2	2 and 4	2 and 3
7	616.5	663	88.6	130	239	40.2	90.6	159.0	44.4	25.3	1 and 2	1 and 4
8	617.6	668	89.4	131	239	40.5	90.8	157.0	44.6	25.8	1 and 2	1 and 4
9	602.5	680	91.0	132	239	41.2	88.6	161.0	46.5	25.6	1 and 2	1 and 4
11	553.5	622	83.2	132	239	37.6	81.3	145.0	46.2	25.9	2 and 3	1 and 4
12	[illegible]	412	55.1	132	239	24.9	45.7	75.2	54.5	33.1	2	4
25	776.1	889	118.8	135	239	53.8	114.3	204.0	47.1	26.4	2, 3 and 4	1, 2 and 3
26	582.4	705	94.3	135	239	42.7	85.6	163.7	49.8	26.1	1 and 2	3 and 4
27	470.8	546	73.0	132	239	33.1	69.2	128.7	47.7	25.7	3 and 4	2 and 3
			II. Input to motors from revolutions of disks of watt-hour meters. Output from wells measured volumetrically									
28	613.3	746	99.8	131	239	45.2	90.7	159.7	49.8	28.3	1 and 2	1 and 4
30	[illegible]	735	98.3	133	239	44.5	90.8	159.3	49.0	27.9	1 and 2	1 and 4
32	[illegible]	338	45.2	130	239	20.5	45.6	78.6	45.0	26.1	1	1
34	302.4	399	53.3	131	239	24.1	44.4	79.5	54.2	30.3	1	4
36	303.2	399	53.3	132	239	24.1	45.3	81.5	53.2	29.6	2	4
38	226.4	314	42.1	133	239	19.1	33.3	63.7	57.3	29.9	3	1
40	480.4	652	87.2	133	239	39.5	70.6	128.4	57.0	30.8	3 and 4	2 and 3
42	226.4	275	36.7	133	239	16.6	33.3	63.3	49.8	29.3	4	3

SUMMARY OF AIR LIFT TESTS AT FORT BLISS.

In preparing the plans and specifications for the plant consideration was given to the desirability of making frequent operating tests of the different portions of the plant, with the result that it was determined to provide in the permanent installation such gages and meters as would be necessary in obtaining the desired data.

The series of tests, or trial runs, on the air-lift installations is divided into two sets. In the first set, the power input to the compressor motors was obtained from readings of the recording dials of the watt-hour meters on the switchboard; the speeds of the motors and compressors by means of revolution and stroke counters; the rate of delivery of compressed air to the wells from readings of the scale of the manometer of the air meter; the air pressure from gages on the air receivers and at each well head; and the rate of delivery of water from the wells from the weir gage. In the second set of tests the power input to the compressor motors was obtained by counting the number of revolutions of the rotating disks in the recording watt-hour meters, the rate of delivery of water from the wells from actual volumetric measurements by means of the surface reservoirs, and all other data as in the first set. The methods of obtaining the power input to the motors and the rate of delivery from the wells, as used in the second tests, are thought to be much more accurate than those used in previous tests, because unit rates are derived from totals for a given period of time rather than from direct observations.

Results calculated from data obtained during the tests described are given in the accompanying table. The average efficiency of the air-lift for the first set of tests was 48.1% and for the second tests 51.9%. The average overall efficiency (wire to water) for the airlift end of the plant for the first set of tests was 26.4% for the first and 28.66% for the second set of tests.

The average power requirement for lifting water from the wells to the surface reservoirs is 2.77 kw.-hr. per 1000 gal. of water, and that for pumping the water from the surface reservoirs into the distributing system is 0.798 kw.-hr. per 1000 gal., under average working conditions of pressure and rate of delivery. At an average cost of 1.5c. per kilowatt-hour, the actual cost for power alone for delivering 1000 gal. of water into the distributing system is 5.34c. The cost for the pumping station crew, consisting of a chief engineer and one assistant engineer and one laborer on each of three daily shifts, and also including the cost of incidental supplies, such as lubricating oil and waste, is 1.66c. per 1000 gal., making the total actual cost 7c. per 1000 gal. The actual outlay of funds for this plant is $101,767, the original installation, including the two 10-in. wells, having cost $42,700 and the addition to the plant, including the two 12-in. wells, having cost $64,067. Interest at the rate of 4% upon the cost of the installation, and depreciation of equipment at the rate of 5%, are provided for by adding 2.63c. per 1000 gal. making the total cost for supplying water 9.63c. per 1000 gal., on the basis of a plant capacity of 1,000,000 gal. per day. Prior to the completion of the plant, water purchased from the El Paso Water Co. to supply the needs of Fort Bliss cost 20c. per 1000 gal. At an average daily demand of 1,000,000 gal., the annual saving to the Government effected by the operation of this plant is $37,850. If the plant capacity is taken as 1,500,000 gal. per day, which is its normal working capacity, providing for the shutting down of one compressor and one well, the total cost of supplying water is 8.21c. per 1000 gal., and the annual saving to the Government is $64,550. Taking the plant capacity as 2,000,000 gal. per day, which is the ultimate capacity of the present installation, the total cost per 1000 gal. is 6.74c., and the annual saving is $96,798.

Education in Compressed Air Practice

THE SYMPOSIUM in the July COMPRESSED AIR MAGAZINE, on the topic of additional educational facilities for students of the usages of compressed air and its hundreds of applications in general engineering and manufacturing, called forth a great variety of opinionative comment and apparently stirred very great interest in the subject. Letters from all quarters of the country continue to reach the editors, who feel encouraged to believe that the discussion thus begun will have excellent results.

Interested educators will no doubt preserve these expressions on the subject, as will engineers and manufacturers that have a direct concern in the practical suggestions offered. We are glad to present herewith additional letters which either were received too late for publication in the July issue, or which we could not publish for lack of space.

By H. L. DEAN
Chicago Pneumatic Tool Company

I am of the opinion that a special, detailed course on the subject of compressed air and its application should not be confined or concentrated in any one institution, but the aim should rather be to have such a course, even if necessarily somewhat abbreviated, form a part of the regular mechanical engineering course now given in many schools.

I am further sure, that such a course is now existent at several institutions, but at the same time its inclusion to a greater and more universal degree would certainly prove of great value to the student and naturally, ultimately to the Compressed Air Industry and to engineers in general.

I do think, however, that certain well known authorities on compressed air, its uses, practical applications and the details of development of present day air compressors and their accessories, should if possible, be secured to give a series of lectures at noteworthy schools now giving courses in compressed air, the idea being to supplement the student's theoretical knowledge with some phases of the practical side of the subject.

The above summarizes my views very briefly, but I shall give earnest attention to the articles in COMPRESSED AIR MAGAZINE.

By H. L. HODGKINS
Dean, George Washington University, Washington, D. C.

In reply to your recent letter asking our views as to whether an additional course on compressed air should be offered in our technical institutions, our professor of mechanical engineering advises me as follows:

He believes that it would be wise to establish a special chair in that subject in a few of the larger institutions, but does not deem it possible to suggest the particular ones. He also feels that the scope of the course that might be given had best be determined by a conference between the appointed instructors and the practical men in that field. He is inclined to advise that a course be given by special instructors who are engaged in practical work rather than by a man giving his whole time to the teaching.

BY JAMES L. MORSE
Professor of Mechanical Engineering, Colorado School of Mines, Golden, Colo.

It seems to the writer that in view of the fact that the subject of compressed air has been treated very fully in the way of theory and from the subject of thermodynamics that the idea of establishing a special chair of compressed air engineering in various schools is advisable only under the following conditions:

That schools desiring to make this provision agree to send a field man out to investigate actual plants in operation and study them and also to visit the factories where these plants are made and study in detail both manufacturing and operating conditions and correlate these conditions so far as possible with the technical side of this branch of engineering. Conclusions could then be drawn as to what is good in the way of harmonizing theory with practice.

It seems to the writer that another way to handle this question in a satisfactory manner is for the COMPRESSED AIR MAGAZINE to establish a section devoted entirely to the practical side of operation of compressed air plants in actual practice and solicit articles from those actually in charge of plants and from testing engineeres who are in position to furnish information relative to the actual performance of such plants throughout a period of time long enough to be representative of what they will do.

It will undoubtedly be a mistake to recommend that special additions to faculty or curriculum be made in the schools unless the field and factory investigation mentioned above is strictly adhered to, because the subject as now treated in the school is as complete and correct as it can be made while it continues to be handled as it is. We must get into the field and study conditions therein in order to add anything worth while to the subject, which can be taught in the schools of engineering.

I would say therefore, that any school or engineering society willing to devote the time and energy to make an exhaustive field and factory study of this subject would be the ideal institution or society to collect and place at our disposal such information as would be useful, practical and positive, and, which would eliminate such doubtful discussions as are now necessary in the average class room because of a shortage of actual operating data, which always decides the success or failure of any material construction.

BY JAMES T. LEE
Vice-President, Vulcan Engineering Sales Company, Chicago

We hesitate in giving any advice as to how the very important subject of compressed air could be best presented to the student in a technical course, and therefore will refrain from trying to answer specifically your questions addressed to the Hanna Engineering Works.

The opinion seems to prevail in the trade that compressed air as a medium for transmitting power is very expensive, and this is occasioned by its abuse rather than its economic use. Apparently any sort of a pipeline or connection is considered good enough for compressed air, and as these lines are quite usually of a flexible nature there arises great opportunity for leaks.

No one would think of putting down a hydraulic line in as flimsy a way as they would a compressed airline and, of course, stringing wire for electric current is a very carefully schemed matter, both on account of protection of employes and to fill ordinance specifications, so that with hydraulics and electrics the same sort of lossage due to faulty installation, does not arise and these latter elements for transmitting power are therefore glorified without reason.

We find a power cost fallacy exists in the minds of the trade with several machines of our manufacture when compared with electrically operated devices of similar nature. For instance, a straight lift hoist which is illustrated in our hoist catalogue No. 12, will lift a load more economically a given number of times per day than an electric hoist of the drum type.

Also, a pneumatic jolt ramming machine will perform its functions with a power expenditure of approximately twice that of the electric type of jolt ramming machine. This statement, however, does not favor the electric jolt, as for instance, on a machine with 5000 lb. capacity, the yearly horse-power saving will approximate one-half horse-power or $25, against which there is a first cost of possibly $250 in favor of the pneumatic type of machine. In other words, it would take ten years' operation on the part of the electric jolt to overcome the difference in first cost of the two machines, against which you would have the very excessive repairs on the part of the electric jolt due to motor operation in the sand and the multiplicity of parts.

We recognize the importance of your subject and what you are endeavoring to accomplish. I wish you all manner of success in the premises, and we will be very glad to assist you in any manner we can in this connection if you will kindly indicate how this may be done.

By E. B. HUBER, M. E.
Chambersburg Engineering Company, Chambersburg, Pa.

Regarding the best method to follow in establishing a course in our technical schools covering the uses of compressed air, I would say that personally I am very much interested in this subject and am very glad to note that you intend to devote more time and energy to further its study.

I do not pretend to know very much about compressed air and therefore will not undertake at this time to reply to your several questions, but would say that I am in hearty sympathy with your undertaking and trust you will be successful in interesting the engineering world in the need of such training.

I have had occasions in a number of instances to use articles appearing in the COMPRESSED AIR MAGAZINE which referred particularly to the use of compressed air for operating machines manufactured by us and we appreciate very much the good work you are doing in this field. We wish you continued success.

By EDWARD A. RIX
President, Rix Compressed Air and Drill Co., San Francisco, Calif.

No school of lesser rank than an university could give proper training and after the regular preliminary training, during the freshman and sophomore years, a student should, at the beginning of the junior year, make a major study of pneumatics if he ever expects to follow that line, and this requires a special chair at the university that will give a student a working familiarity with the simple heat laws that form the basis of the compression and expansion of gases, and from them deduce in workable form the equations which we use to determine all the phenomena that takes place in the compression and expansion of all gases with practical co-efficients that can be depended on.

There should be lectures on the:

Transmission of Gases in Pipes
Retreating
Stage Compressing and Expanding
Refrigerating and Liquefaction.
Treating of Moisture
Altitudes
Vacuum Pumps and Formulae
Air Lift Pumping
Pumping with Direct Acting Pumps
Motors for Air and Efficiencies
Pneumatic Tools of all kinds
Air in Industrial Plants and Processes
Spraying, Atomizing and Painting
Measuring of Air
Economy and Efficiencies
Determination of Speeds
Air Turbines
Ventilation, Blowers and Suction Fans
Valve Designing and Port Openings
All the various constructions in compressor designing that pertains to jackets, pistons, packings, frames, journal rods, etc.

There is enough to keep a professor and some assistants very busy to teach, arouse enthusiasm and connect it all up with modern practice.

By E. B. STEVENS
Executive Secretary, University of Washington, Seattle, Wash.

In our Engineering College we already teach the underlying principles of mechanical engineering which are involved in the manufacture and use of compressed air machinery. From the standpoint of the present demands our department of mechanical engineering would not be justified in offering more detailed instruction in this field. Opportunity exists at the present for students with special interests to do thesis work along this line.

By G. L. LARSON
Associate Professor of Steam and Gas Engineering, College of Mechanics and Engineering, The University of Wisconsin, Madison, Wis.

"Compressed air" is offered as an elective course in the mechanical engineering department of the University of Wisconsin, and we have found very little demand for it. All of the men taking engineering study the fundamentals of compressed air and air compressors in their course in thermodynamics and we do not feel justified in requiring the men to take a special course in the subject since only a small percentage of our students come in contact with the specialized problems of compressed air after they graduate.

D. C. Williams, of the Western Exploration Co., is in Kingman, Arizona, making preliminary arrangements to unwater the Flores mine, in the Cerbat Range, Mohave county, Arizona.

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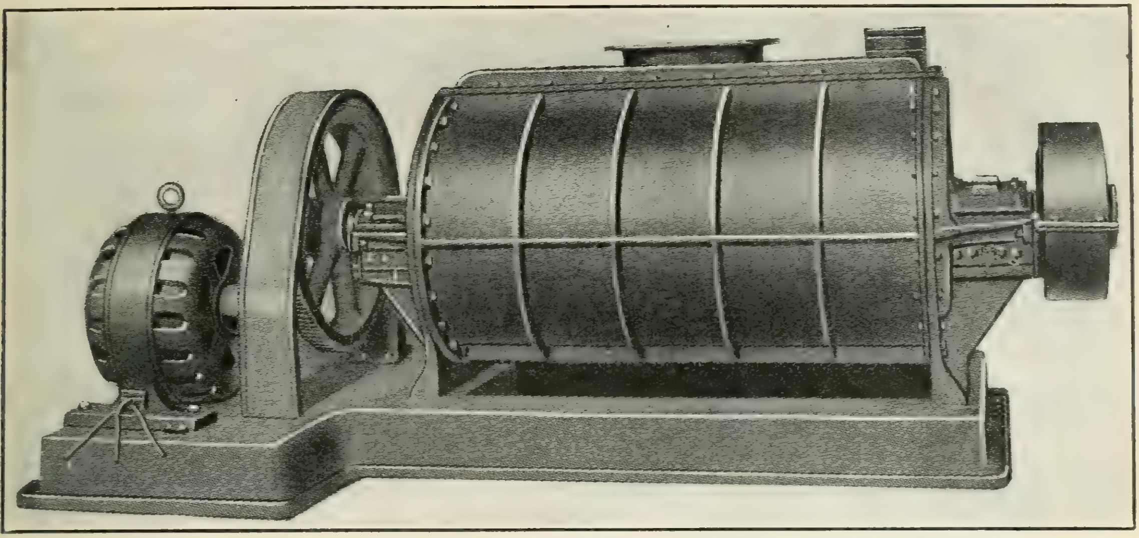
H. H. Stout has resumed his former position as superintendent of the Copper Queen smeltery at Douglas, Ariz., after serving with the engineers in France, with the rank of lieutenant-colonel.



SELF-CONTAINED MOTOR-DRIVEN DISPLACEMENT BLOWER.

Displacement Blowers in Cupola Practice*

In the application of blowing equipment to cupolas, two questions invariably come up: how much air is required and against what pressure must this air be delivered? Somewhere between the extreme of either of these particulars there lies a best condition, which, unfortunately cannot be determined by theory alone, because the interaction between glowing carbon, oxygen, carbon monoxide and carbon dioxide is so complicated as not to be amenable to mathematical treatment. The best depth of stock, and the smallest ratio of coke to iron must therefore be worked out from careful experiments in practice. This means that the rate of charging, the rate of combustion and the rate of melting, after these have been determined, must be constant and regular. For the latter requirement a constant delivery of blast is necessary.

With apologies to those who are familiar with air moving apparatus, the centrifugal and the positive displacement type of blowers are shown by sketches in Figs. 3 and 4. Fig. 1 gives, besides other data, the characteristics of the two types of blowers, by which word is meant the curve expressing the relation between volume of air delivered by the blower and discharge pressure, both for a given intake pressure and for a given speed of the machine.

It will be noted that, for a given change of pressure, the delivery of the centrifugal machine varies much more than that of the displacement machine. The same illustration also contains the characteristic of a cupola for a given depth of stock, given brand of coke, etc. By characteristic of a cupola is meant the curve showing how the pressure at the wind box varies, if more and more air is delivered to the cupola. The point where the cupola characteristic and the blower characteristic intersect determines the pressure and the air delivery which are established.

The other characteristics shown in Fig. 1 belong to different depths of stock in the cupola. It is evident that the resistance to flow is greater with a deep burden than it is with a low burden. These cupola characteristics have been marked low resistance, average resistance and high resistance. For the sake of simplicity assume that in a given case charging is practically continuous. Also assume that, for some reason or other, the resistance to flow through the cupola is temporarily increased, for instance by slag clogging up a tuyere. Then the air delivery is decreased a small amount, if the displacement machine is used, and a much larger amount if a centrifugal machine is used.

The immediate consequence is a growth of the depth of the stock, because decreased air delivery means lower rate of combustion, and because the melters keep on charging as before. But a higher stock line means still greater increase of resistance, further reduction of the air delivery, further reduction in the rate of combustion, etc., in a cumulative manner.

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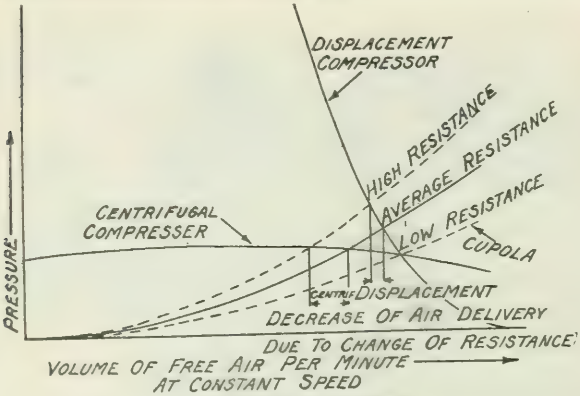
*Condensed from a paper before the Milwaukee Meeting of the American Foundrymen's Association, by Professor W. Trinks, of the Carnegie Institute of Technology, Pittsburgh.



APPLICATION OF CHARACTERISTICS

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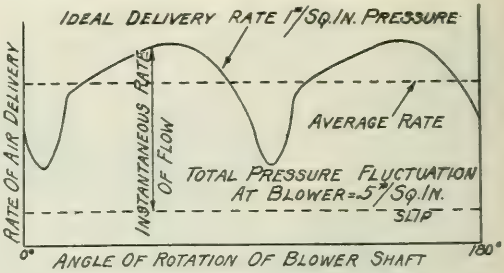
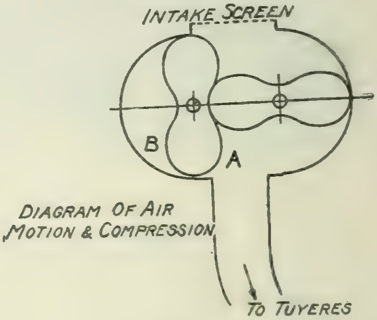


AIR DELIVERY FOR 16 oz/SQ.IN. PRESSURE

5



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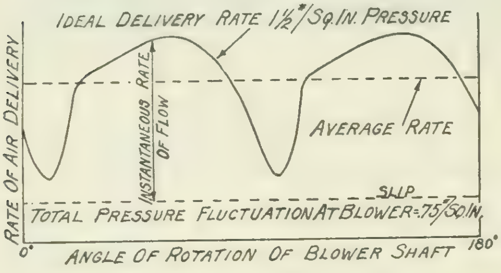

AIR DELIVERY FOR 24 oz/SQ.IN. PRESSURE

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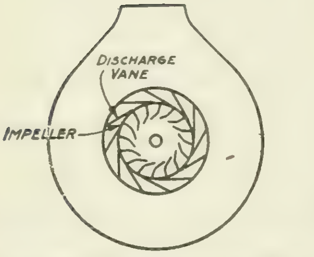
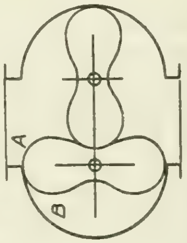


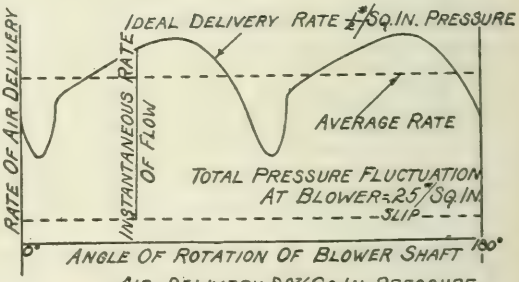
VELOCITY TYPE OR CENTRIFUGAL BLOWER

3



DISPLACEMENT TYPE OF BLOWER

4



AIR DELIVERY 8 oz/SQ.IN. PRESSURE

7

The cumulative effect is pronounced with a centrifugal blower. According to the diagram, Fig. 1, a similar effect should be noticeable with the displacement blower, except that its lack of stability should be smaller and in consequence the changes in rate of delivery should be very much slower. The feature causing this difference is vibration in the discharge line of any displacement blower.

The vibration is caused by the circumstance that the space *B* in the position shown in Fig. 6 carries atmospheric pressure, while the space *A* carries discharge pressure. An instant later *B* is in communication with *A* and a weight of air depending upon the pressure difference between the discharge and the inlet rushes back into *B* until the pressures are equal. Evidently, the delivery of air is diminished during the period of flow-back or of pressure equalization. Figs. 7, 5 and 2 show the ideal rate-of-delivery curves for 1-2 pound per square inch, 1 pound per square inch, and 1 1-2 pounds per square inch pressure in the delivery pipe.

In these illustrations are likewise indicated the pressure fluctuations which under average cupola service conditions establish themselves as a direct result of the vibrating rate of delivery. While, in some kinds of blower service a steady stream of air with little or no vibration may be desirable the same vibration is extremely beneficial in cupola operation. It should be noted that the vibration can be practically eliminated in cases where its presence is harmful by forming the discharge end of the blower in the shape of an air chamber.

Going back to the example of a slight increase in the resistance to flow, caused for instance by the clogging up of a tuyere, it follows from Fig. 1 that the air delivery with a displacement blower drops only a little. It also follows from the same illustration that the pressure rises considerably. And finally, it follows from Figs. 7, 5 and 2 that the pressure fluctuation or vibration grows. But the combined effect of greater pressure and of greater vibration loosens the stock in the cupola to such an extent that the resistance is quickly restored to its original value.

Inversely, should the resistance drop below the normal value, then the pressure will drop considerably, and the vibration will decrease, all of which tends to bring the resistance back to its former value.

BLOWER MUST BE OF PROPER SIZE

While the displacement blower makes for stable and steady operation of the cupola, it is important to select the right size of blower for the cupola so as to utilize to the fullest extent the self-regulating properties of the displacement machine. It should be noted that most blowers are now motor-driven and that, with increasing centralization of power generation, more and more of the motors are of the alternating current type. But in this latter type, speed adjustment without loss is impracticable, except in large units where initial expense counts little compared to what may be saved in operation.

In the sizes of alternating current motors which are used in connection with foundry blower service, the speed can never be increased over the economical speed, and can be reduced only at the expense of continually dissipating electric energy.

If a mistake should have been made in the selection of the size of the blower as a rule it is cheaper to change the gears or pulleys between the motor and the blower than to put up with the continued losses day by day. For, if the blower is too small, the melting capacity is reduced, which means a loss in tonnage, and if the blower is too large too much heat goes up the stack, while the iron is oxidized. These losses can be avoided by opening a bypass on the blower, but that means loss of power and interference with the self-regulating features of the blower. However, there is really no excuse for selecting the wrong size of blower, except perhaps the necessity of buying a second-hand machine to avoid initial expense. But usually the purchaser in such a case pays dearly in the long run for the initial saving.

No matter how much we may strive to make machinery fool-proof, it will require some attention. Postive displacement blowers have self-oiling bearings which are closed against dirt and dust, and have self-oiling gears. And yet, with all these precautions, the lubrication is not that of the ideal oil bath, which is the dream of every designer of machinery. Accordingly, slow wear occurs. Every few months the dirty oil must be drawn off and replaced by clean oil. The machine should be inspected at least once a week to see whether wear may have taken place due to some unforeseen reason. Undue wear can usually be discovered from the color of the oil, or from a scraping noise of the impellers in the casing.

Once a year the inlet screen should be removed, the impellers should be placed vertical, one after the other, and the clearance between the top of the impeller and the casing should be checked up. The bearings are adjustable so that the correct clearances can easily be re-established if wear should have occurred. By adjustment before excessive wear takes place much is saved.

CHARACTERISTICS OF DIFFERENT EXPLOSIVES

The relative merits of different classes of explosives were given by Professor J. Young in a recent lecture, as follows: Where the material is to be displaced, but not shattered, a slow-acting explosive is required. Black gunpowder, with a velocity of explosion of 300 m. per second, is good. Blasting powder is still slower in action, and is suitable for quarrying where stone has to be obtained in large blocks.

Bobbinite, still slower in action, is much used in coal mines with soft coal. All these are comparatively weak explosives, and large charges are required.

Where great power and rending effect, with a moderate shattering effect, is required there is little to choose between the ammonium nitrate class and the perchlorate explosives, except that the former are the safer to handle, but most susceptible to moisture.

Some grades of amatol made for military use would also be suitable, and vast quantities should now be available. Where the greatest power in the smallest bulk is required—this will be the case where hard rocks are to be blasted and small drills are used—the nitroglycerine explosives are decidedly best, as they have a high density, great power, and a high velocity of detonation.

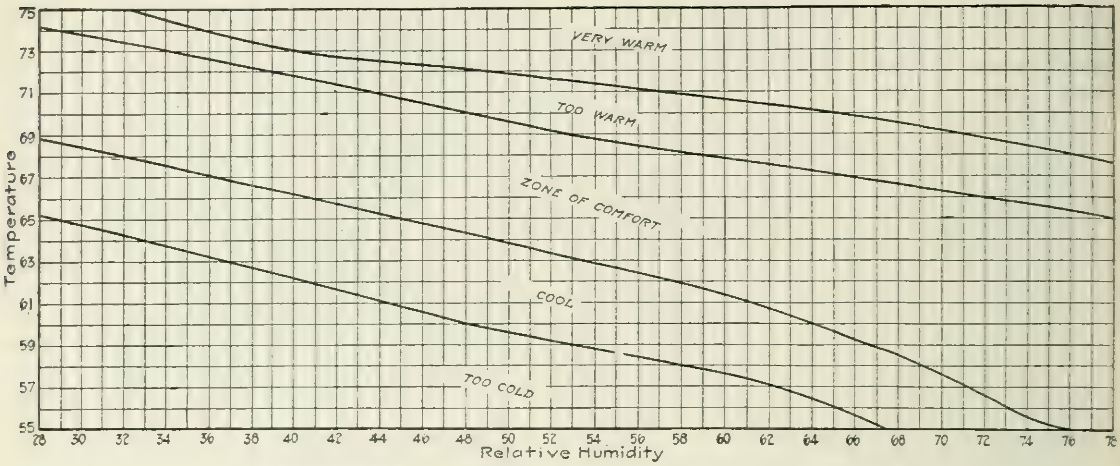


CHART SHOWING HUMIDITY INCREASE AND COMFORT DECREASE

Fuel Economy in Humidity Control

By *F. J. McCULLOUGH**

A NUMBER of the Illinois State buildings are heated by fan or hot-blast systems. The average condensation in the coils per square foot of surface per hour is 1.56 lb. when heating air from 30 to 105 deg., but in zero weather, heating air from 0 to 105 deg. will condense 2.26 lb. per hour, or an increase of 45 per cent. It is evident that when the building is being warmed up in the morning and has few or no occupants, all the outside air should be shut off, and the air in the building recirculated by proper damper arrangement.

Modern ventilating systems are designed for delivering from 25 to 30 cu.ft. of air per minute for each occupant. This will maintain a standard of purity of the air which has arbitrarily been decided upon, but this amount of air can be reduced almost one-half before any perceptible effect is noticed on the occupants. Then, as the ventilating apparatus takes 45 per cent. more steam when the outside air is down to zero, there is no reason why the standard for purity of air cannot be reduced during this time by recirculating from one-third to one-half of the air, and taking the remainder from the outside.

From a study of temperature records of the various State institutions it is evident that one serious loss is due to overheated buildings. These records show many instances of temperatures of from 75 to 80 deg. Temperatures may be considerably lower if attention is given to the humidity, the moisture in the air.

In summer the relative humidity in this climate is usually 60 to 70 per cent., and as the windows and doors are open it is the same indoors as outside. With this humidity a temperature of 65 to 68 deg. is comfortable. In winter the outside humidity is about the same, but as the air is heated its capacity for moisture increases, so that the relative humidity is much less. In a steam-heated room it is seldom over 25 per cent. and is frequently less.

The accompanying illustration is a reproduction of a chart prepared by the Chicago Commission on Ventilation, who made a test of the Chicago Normal School a few years ago. From the chart it can be seen readily that as the humidity increases the temperature for greatest comfort decreases, and vice versa.

These experiments showed conclusively that with a relative humidity of 55 per cent. and a room temperature of 66 deg. the occupants were just as comfortable as with a humidity of 25 per cent. and a room temperature of 74 deg., as may be determined by extending the chart slightly at the left.

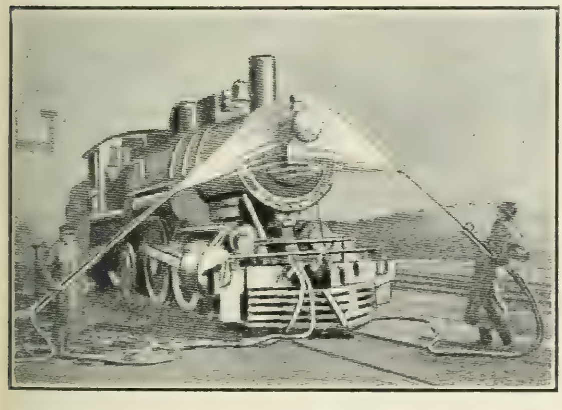
In the latitude of Chicago the average outside temperature during the heating season is 34 deg. To keep a room at 66 deg. it is necessary to maintain a difference between inside and outside temperatures of 32 deg. With a room temperature of 74 deg. the difference is 40 deg. The heat losses from a building by radiation or air changes is in direct proportion to the difference between inside and outside temperatures, so to maintain a temperature of 66 deg. inside means a relative heat loss of 32 and to maintain 74 deg. means a relative heat loss of 40, or an increase of 25 per cent. in the amount of heat required to maintain the higher room temperature.

**Abstract of a paper delivered before chief engineers of Illinois State Institutions.*

The saving of heat by carrying higher humidity and lower temperature will be somewhat less than the 25 per cent., because some steam will have to be introduced into the room to raise the humidity and only a small part of the total heat of this steam will be given up to raising the room temperature. The amount of steam admitted into the room to maintain the humidity will be small, as compared to that required to maintain the room temperature, however. A saving of, say, 15 per cent. of all the steam used for heating would be worth trying for.

THE D. & M. LOCOMOTIVE CLEANING PROCESS

A method of cleaning locomotives which reduces the cost of the work and also eliminates the objectionable features, is now being installed upon railroads by the D. & M. Cleansing Process—the product of a Chicago company. By this process, which is shown in operation in the half tone here reproduced from *Railway Age,* a mixture of air, oil and water is sprayed on to the locomotives at a uniform pressure of about 90 lb. The nozzle discharges the mixture in a spray which is directed against the surface to be cleaned at an angle of about 45 deg. from a distance of about 18 in.



HOW A LOCOMOTIVE IS CLEANED BY THE D. & M. PROCESS.

One gallon of oil is used to about 300 gal. of water, the proper mixture being secured by regulating valves attached to a special oil tank. The mixture of oil and water is carried to the nozzle by a ¾ in. rubber hose, the stream being broken up at the nozzle by air supplied through a ½-in. nipple. The air and water pressure should be as nearly equal as possible and approximately 90 lb. per sq. in. The temperature of the water should be about 100 to 120 deg. F., as cooler water does not produce as good results. The oil used is a light straw colored gas oil or petroleum distillate having a paraffine base and ranging in gravity from 32 to 36 deg.

The cleaning can be done inside the roundhouse if desired, but is more conveniently handled at some point on the track by which the engines reach the house. No difficulty is experienced in using the process in severe winter weather, and it has been operated with entire success at zero temperature.

When the D. & M. process is regularly used, locomotives can be thoroughly cleaned by two men in from 10 to 12 min. The cost, including labor, material and up-keep of equipment will not exceed 30 to 40 cents per cleaning. The first cleaning requires more time, as it is necessary to remove the accumulated dirt and oil.

AIR BOOSTER FOR CENTRIFUGAL PUMPS

Two single-stage centrifugal pumps were insufficient to keep down the water at the Algoma mine, Ironton, Minn., when the flow increased owing to the cessation of pumping at an adjoining property, says H. H. Hunner in *Engineering and Mining Journal.* One pump was driven by a 75-hp. motor at 1750 r.p.m., rated at 1290 gal. per min. against a 165-ft. head, and was pumping at approximately this head. The second pump was direct-connected to a 100-hp. motor making 1750 r.p.m., and was rated at 1500 gal. per min., with a 170-ft. head. Suction and discharge for both pumps were 6-in. diameter pipes.

Elbows on the discharge pipes were tapped for 1-in. pipe connections about five feet from the pumps, connected to an air line, and the valves were slightly opened on a 90-ft. air pressure. The added pressure increased the capacity of the pumps by 200 or 300 gal., which was sufficient to take care of the increased flow of water. The small amount of air used was not noticeable on the air line.

B. H. Prater has been appointed engineer of maintenance of way of the Oregon Short Line R. R., with headquarters at Pocatello, Idaho, succeeding R. B. Robinson, transferred to the Union Pacific R. R.

DUST INFLAMMABILITY TESTS

The following is an account of inflammability tests made on samples of gas black submitted to the Bureau of Mines by the B. F. Goodrich Company, Akron, Ohio. It is likely that this gas black was produced by the incomplete combustion of natural gas.

The sample was first sent to the coal laboratory for the analysis regularly given to coal dusts which are to be tested for explosibility. The results of the analysis of the sample as received follow:

Moisture	1.66
Volatile Matter	6.14
Fixed Carbon	92.04
Ash	.16

It is to be noted from this analysis that the volatile content is very low, also the moisure content. It was impossible to obtain a true size-test since the material balled up and would not pass through the screens. Microscopic examination shows it to be very finely divided.

It has been established in the Experimental Mine of the Bureau of Mines at Bruceton, Pa., that a mixture of 200-mesh Pittsburgh coal dust with shale dust, in the proportion of 30 per cent. coal to 70 per cent. shale, will propagate an explosion. The volatile content of this mixture is about 12 per cent., nearly 100 per cent. higher than that of gas black. While this coal dust mixture is about 15 per cent. carbon, the gas black is 85 per cent. carbon. It is apparent, that if the gas black is explosive, its explosive properties will be due to the finely divided carbon rather than to the volatile content. Generally speaking, the finer a dust, the more easily it is ignited. In connection with certain factory explosions, C. Engler has recorded experiments on the inflammability of soot. He could not explode a mixture of air and soot, but found that a mixture of gas and air otherwise non-explosive could be made to explode by introducing a soot cloud.

DIFFICULTY OF IGNITION

To get a relative idea of the inflammability of the dust, a cloud was blown from a glass tube across the flame of a Bunsen burner. No inflammation was obtained, the particles directly in the flame appeared to burn. This seemed to indicate that considerable difficulty would be encountered in getting an ignition of the dust.

Tests were then made with the Clement-Frazer apparatus. This apparatus (described in Technical Paper 141 of the Bureau of Mines) consists essentially of a small electrically heated platinum coil within a glass globe. In it a sample of dust is blown up against the coil, and the pressure of the explosion, as recorded by a pressure-indicator, is taken as an index of the inflammability of the sample. In this case, 100 and 300-mg. samples of the gas black were projected up against the coil, and in spite of the fact that the coil was heated to 1,200 degrees C., no inflammation took place. This test can not be regarded as conclusive, for, although this apparatus has been found to be very efficient in testing highly inflammable coal and other dusts, it has failed to ignite a number of dusts undoubtedly very inflammable. This was the case, for example, with aluminum dust (see Technical Paper 152 of the Bureau of Mines). Probably the failure to ignite these dusts is due to the fact that the heat coil has too little heat capacity to heat the dust sufficiently in the short time of contact. Experiment seems to justify this explanation, since aluminum dust, when poured into or blown across a small earthenware dish heated to 800 degrees C. has been found to ignite readily, with a blinding flash.

This latter test was tried with the carbon black, but, when poured into a dish heated to 1,100 degrees C., this dust gave no ignition whatever.

A DUST EXPLOSION GALLERY

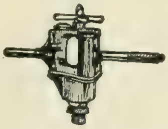
There is being developed in the Pittsburgh laboratory a dust explosion gallery in which it is hoped that the explosibility tests at the Experimental Mine can be duplicated. The gallery is not yet completely standardized, but the work has been carried far enough so that tests of finely divided dusts can be made. In this gallery a prearranged dust cloud is formed by the explosion of a small charge of powder which blows the dust into the gallery from a number of jets arranged throughout the length of 14 feet. A second powder shot ignites this dust cloud. Very inflammable dusts are ignited by a quiet flame produced by the burning of ten grams of rifle powder piled loosely on the floor of the gallery at the rear. Dusts not so inflammable can be ignited under high pressure in the gallery. This pressure is obtained by stopping down the front end of the gallery and greatly increasing the force of the powder shot through loading the powder into a small cannon.

It was found that the gas black would easily ignite and readily propagate a flame under the con ditions first described, when the gallery was loaded with 12-gms. per cubic foot of space. This easy ignition was probably due to the fact that the concussion of the dust-raising shot separated the gas black and caused a good mixture with the air.

Experiments were then conducted to determine the amount of shale dust which it was necessary to add to the gas black to make it non-explosive under the conditions at the Experimental Mine.

This was done in order to make a comparison of its explosibility with that of Pittsburgh coal dust. By using the second method outlined for the experimental gallery, it was found that a mixture of 60 per cent. by weight shale dust and 40 per cent. gas black would just fail to explode under mine conditions. Since the corresponding mixture of shale dust and coal dust is 75 per cent. shale and 25 per cent. coal, the gas black appears to be nearly as inflammable as coal dust, if the right conditions are obtained for its ignition.

The above experiments show clearly that the sample of gas black is not easily ignited, but that, if conditions are right for ignition, it is very explosive. In other words, the gas black can be classed with dangerous factory gases.



ARTIFICIAL RESPIRATION*

For more than a century, England has had several life-saving societies, and many special commissions have been appointed to investigate the methods employed in resuscitation. In this country, about six years ago, a commission on resuscitation from electric shock was created for the first time, by the initiative of the National Electric Light Association. It is now generally recognized that efficient artificial respiration is, for such conditions, the best and practically the only means available for resuscitation.

Dr. Meltzer demonstrated in the laboratory for physiology and pharmacology, the efficiency of the method of pharyngeal insufflation in an etherized dog after complete removal of the anterior wall of the thorax, in which the lungs and heart were exposed to full view.

Dr. Rossiter of the Carnegie Steel Company, demonstrated the latest device of the Pulmotor company, which is not identical with the original pulmotor. He showed also the original pulmotor and stated he had resuscitated eight gas cases with it, in which respiration had stopped.

Dr. James H. Booher, medical director of the Life Saving Devices Company, demonstrated the lung-motor. He showed a number of blood-pressure tracings, taken from animals which had received artificial respiration by means of this apparatus. Dr. Booher stated that in these experiments the lungmotor was connected with the animal by means of a tracheal cannula. In human cases the lugmotor is applied by means of a face mask.

In introducing Mr. Foregger, the chairman explained that the physician who was most competent to present the details of the apparatus of the Foregger company is now in France. The apparatus consists in modifications of the insufflation apparatus of Meltzer. Among other changes, the apparatus carried an oxygen generator tank. In reply to a question, Mr. Foregger stated that the oxygen thus generated may last 8 or 10 minutes.

W. C. Eglin, the chairman, read a letter from M. W. Alexander, of the General Electric Company, stating that he hoped the "commission would be very definite in recommending the prone-pressure method, as experience has proved its value." C. B. Scott stated that the accident prevention committee of the N. E. L. A. had reached the point in its investigation where it felt that the prone-pressure method was best to recommend, bearing in mind that machines are not always available in emergencies.

Dr. Schubmehl stated that the prone-pressure method has been most successfully applied by their 225 first-aid men. Mr. MacIlchlan stated that he had the duty of training possibly 3,000 men in the prone method. Their system required the men to practice this method at least once a month. The men are instructed not to desist in less than 3½ hours, and that not till then should they listen to a physician.

The secretary read the following part of a letter from Prof. Schafer, of Edinburgh:

"The prone method has been adopted exclusively for about 12 years by the Royal Life Saving Society. It has also been adopted for several years by the London and other police forces, by the board of trade, by the army and the navy."

SOME RESOLUTIONS ADOPTED BY THE COMMISSION

That reliance upon the use of special apparatus diminishes greatly the tendency to train persons in the manual methods.

That police officers or physicians often interfere with the proper execution of manual methods, in that they direct that the patient be removed in an ambulance to some hospital, thus interrupting the continuance of artificial respiration.

The prone-pressure or Schafer method of resuscitation is preferable to any of the other manual methods, which should be given immediately where victim is found. It is all important that this aid be rendered at once. The delay incident to removal to a hospital or elsewhere may be fatal, and is justifiable only where there is no one at hand competent to give artificial respiration. If complications exist or arise, which require hospital treatment, artificial respiration should be maintained in transit, and after arrival at the hospital, until spontaneous respirations are well developed.

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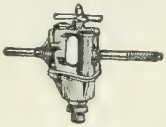
*Abstract from Proceedings, Third Resuscitation Commission.

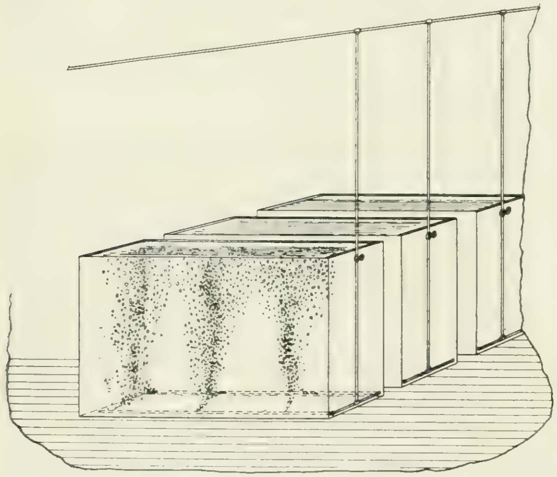
Persons receiving artificial respiration should be kept warm. Artificial respiration is required only when natural respiration has ceased. The commission recommends that in cases of gas asphyxiation, artificial respiration should be combined, when possible, with the inhalation of oxygen from properly constructed apparatus.



AIR AGITATION FOR MOVING PICTURE FILM WASHING TANKS

By H. L. HICKS

COMPRESSED AIR is quite generally used in the motion picture industry for agitating the water in the tanks in which films are washed after development. Data on volumes and pressures required are, however, so infrequently noted that the following figures are worthy of record:



A movie producer, whose film making laboratory is located in one of the large cities of western Pennsylvania, has done considerable experimenting with air agitation in his wash tanks and recommends the layout illustrated here as productive of best results.

Each of the wooden wash tanks in his battery of eight measures four feet in length, three in width and fifty inches in depth and is filled with about four feet of water. At the bottom corners of each tank are installed half inch air pipes extending the four foot length of the tank. Each pipe is drilled with three 1-16 inch holes pointing downward 10 degrees from the horizontal. This number, size and location of holes was found to give most thorough agitation with minimum consumption of air.

To operate the 48 air jets in all eight tanks there is required about 16 cubic feet of free air per minute compressed to a pressure of 5 lbs. per square inch. The air compressor installed was an Ingersoll-Rand Class "ER-1" with a 6 inch diameter x 4 inch stroke double acting cylinder. A three horse power motor only is required as the machine needs operate at only 125 R.P.M., far below its maximum rating.

THE AMERICAN STANDARDS ASS'N

IN MANY LINES of engineering much excellent standardization work had been done before the war; the war emphasized its importance and showed most clearly the need of co-operation to prevent the confusion caused by the promulgation of overlapping standards by independent bodies. During the war the Government Departments co-ordinated these efforts in certain lines and greatly assisted in unifying them.

The American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers and American Society for Testing Materials, recognizing the value of what had been done, invited the Government Departments of War, Navy and Commerce to appoint representatives to act with them to continue this work. The body so formed is the American Engineering Standards Committee. It has required considerable time to definitely formulate its objects, and to arrange methods for accomplishing them that would be effective without in any way interfering with the many organizations that have been doing such excellent work in this line.

The American Engineering Standards Committee has just completed and adopted a revision of its constitution which has been sent to the governing boards of all the departments and societies represented on the committee with a request for its ratification. The new constitution changes the name to American Engineering Standards Association.

The objects of the Association are stated as follows:

1. To unify and simplify the methods of arriving at engineering standards, to secure coöperation between various organizations and to prevent duplication of standardization work;

2. To promulgate rules for the development and adoption of standards;
3. To receive and pass upon recommendations for standards submitted as provided in the Rules of Procedure, but not to initiate, define or develop the details of any particular standard;
4. To act as a means of intercommunication between organizations and individuals interested in the problems of standardization;
5. To give an international status to approved American engineering standards;
6. To coöperate with similar organizations in other countries and to promote international standardization.

Any organizations may request the association to approve standards which it has formulated, or to approve committees that it has appointed, and by so doing becomes a sponsor society. Such a request is entirely at the option of the organization that has formulated or expects to formulate the standard. At the request of the sponsor, approval of the standards is given when they are the substantially unanimous conclusions of a committee made up as follows:

(a) Sectional Committees dealing with standards of a commercial character (specifications, shop practices, etc.), shall be made up of representatives of producers, consumers and general interests, no one of these interests to form a majority.

(b) Sectional Committees dealing with standards of a scientific or non-commercial character shall consist of persons specially qualified, without regard to their affiliations.

The association thus acts only to bring together those interested in a common object, and when they have completed their work, will at their request, certify that it has been done in such a manner as to justify its adoption. Nothing revolutionary is proposed, it is merely an extension of present practice.

The association will act as a bureau of information regarding standardization. It will collect information regarding existing standards and regarding the bodies that have formulated and adopted them. This will enable it promptly to give necessary information to those who select a committee to formulate a new standard or revise an old one.

It will establish relations with similar bodies in other countries and can do much to promote the acceptance of international standards. It is believed to be possible to obtain international acceptance of American standards more easily through such a body than in any other way.

Those consulted believe such an organization is urgently needed. The American Engineering Standards Association will furnish a means by which any organization intending to define a standard can readily ascertain what others are interested, and should be consulted in regard to it. Heretofore there has been no such means.

SUMMER COURSE FOR FACTORY MEN

The Pennsylvania State College of Centre County, Pa., announces that it will conduct this season its fourth summer session in factory organization, cost accounting, employment and scientific management, from August 11 to August 23. Registration day for this course is to be August 9. No examinations are required for entering these courses, but practical industrial experience is desirable. Descriptive bulletin on the course and a registration blank may be obtained by writing to the Department of Industrial Engineering of the college.

This course is offered particularly for men engaged in industrial activities, as foremen, time keepers, cost accountants, store clerks, members of production or planning departments, superintendents and employment managers. The summer course has been arranged to cover a two weeks' period in order to afford an opportunity to men whose vacation period is restricted to two weeks, to combine a summer outing and recreation with acquisition of practical knowledge in their own field of employment.

The lectures and discussions will be conducted by Major Hugo Diemer, Professor of Industrial Engineering at the Pennsylvania State College, whose practical experience includes that of superintendent of the National Motor Vehicle Co., Indianapolis, organization manager for the Goodman Manufacturing Company, Chicago, and consulting industrial engineer for the Cincinnati Milling Machine Company, Fairbanks-Morse Manufacturing Company, International Harvesting Machine Company, and as Major of Ordnance in charge of important munitions work at the U. S. Cartridge Co., Lowell, Mass., and the Bethlehem Steel Co.

At Portland, Oregon, a gas container 70 feet in diameter and 75 feet high, weighing 300 tons, was moved a distance of three miles. First, it was raised 15 feet and loaded on rollers. Then it was moved four blocks through the city streets and lowered 28 feet to a dock, whence it was moved upon a pair of barges. The barges were towed three miles to a shipbuilding plant, where the tank was unloaded and raised 26 feet, moved across newly-filled ground for a distance of 2,000 feet, crossing a railroad track and placed on its new foundation. It took 71 days to complete the work.

It is estimated that the production of nitrogen in Germany has been increased fivefold in connection with the war and that it will shortly amount to 500,000 tons a year.

Spruce Up—Make Repairs Now

By MAJOR CHARLES F. LACOMBE

AT PRESENT, due to the process of readjustment from the condition of war there is a lull in the larger developments of construction work throughout the country.

On account of the pressure of war needs we were compelled to neglect maintenance and repairs to our houses, shops and works. We spent billions of dollars for construction and operation but comparatively nothing for maintenance, although we were running our productive industries above capacity. This we have done for two years; in consequence our property and appliances need repairs.

We can, therefore, very profitably use the present period for making our repairs and "sprucing up" our property. This appeals particularly now, for three good business reasons:

First: It is in line with the savings idea inculcated in the mind of the nation during the war. If we do not maintain, we must repair, if we do not repair, we must replace, if we do not replace, we reach a condition of wreck and ruin. A small amount expended now for repairs is real saving as it saves spending a larger amount for replacement later.

Second: If all concerned begin repairing now, even if the amounts are comparatively small, the aggregate of all the work performed will amount to millions of dollars and materially aid in starting the bigger construction work now necessary.

Third: A prevalent idea exists that prices will fall in the next few months and if we defer action money will be saved. The best informed opinion is that prices will remain stationary except when purely artificial conditions exist and this applies to larger work as well as smaller.

But let us assume that for the smaller work the prices of material will fall. It is not expected that wages will be materially reduced on account of the known shortage of normal supply of labor during the four years of the war. Let us assume an exaggerated drop in material costs of fifty per cent. The ordinary repairs are about seventy per cent labor. If we assume a repair of $1000, $700 is labor, leaving $300 for materials; a fifty per cent. drop in prices means a saving of $150.

If repairs are necessary at all it is safe to say that waiting six months will add additional repairs costing far more than fifteen per cent. of the original estimate so one actually saves by repairing now, besides having the satisfaction of a well maintained establishment, of having helped general business along and further aiding in making work that will employ the returning soldier.

Let us change our mental attitude, instead of denying ourselves the real necessities of upkeep, let us now "spruce up," doff our 1914 clothes, paint our houses, repair our tools, appliances, factories and shops and do it now.

A policy of this kind if worked into the daily life of the many communities in the country will not only improve business, but will improve living conditions, brighten our mental attitude, and show the returning soldier that he was justly proud of his home and people and we are proud of him.

NOTES OF INDUSTRY

The U. S. bureau of mines experiment station at Bartlesville, Okla., has invented a testing apparatus for determining the gasoline content of natural gas. This apparatus has been found to give satisfactory results in cases containing as little as 10 gallons per million feet.

During the war the Henry Ford enterprises had an average of 34,000 men employed at the Ford Motor Co. plant in Detroit; 6800 at the shipyards in River Rouge; 4000 at the blast furnaces in course of construction in the River Rouge district, and 250 at the carburetor plant, making a total average of 45,000 men, practically all on 100 per cent. Government work.

In coöperation with the U. S. Bureau of Mines and the Idaho Bureau of Mines and Geology, the University of Idaho at Moscow offers in the School of Mines a number of fellowships. These fellowships are open to college graduates who have had good training in mining, metallurgy, or chemistry, and who are qualified to undertake research work. The income of each fellowship is $720 per year for the twelve months beginning July.

The hardness of water is usually expressed in degrees, one degree being equivalent to a solution of one part by weight by carbonate of lime or other hardening salts to one hundred thousand parts of water. Wells generally contain the hardest water, 35 degrees of hardness being common. With water of one degree of hardness, the water contained in a single big tender would deposit 75 lbs. of mud or scale-making sediment.

The report of J. L. Ackerson, vice president of the United States Shipping Board Emergency Fleet Corporation, of deliveries, launchings and keel laying of all classes of ships for April and May, 1919, shows that the ship yards of the country are making giant strides in ship production. In April there was a total delivery of 111 ships aggregating 368,476 gross tons, or 543,720 deadweight tons. In April, 1918, the total delivery was 31 ships aggregating 114,274 gross tons, or 171,413 deadweight tons. In May of this year the total delivery jumped to 136 ships of 511,014 gross tons, or 768,025 deadweight tons, as against 43 ships of 169,608 gross tons, or 254,413 deadweight tons, last May.

Launchings also made a high mark of progress in the shipyards. In April, 1919, 118 ships of 390,942 tons, or 586,266 deadweight tons, were sent down the ways. In April, 1918, 46 ships of 150,152 gross tons, or 225,220 deadweight tons, were put overboard. In May of this year 137 ships of 470,634 gross tons, or 705,958 deadweight tons, took the water as against 74 ships of 243,502 gross tons, or 365,255 deadweight tons, in the same month last year.

Investigations by the motor truck committee of the National Automobile Chamber of Commerce indicate that farmers throughout the country will have in use 300,000 motor trucks by the end of the year. According to further estimates this will have retired 1,200,000 horses. Every horse displaced means five more acres of land that can be devoted to raising food.

After having devoted almost its entire energies toward helping to win the war by giving over to the common cause its experts, that they might through their peculiar knowledge develop new methods of destruction of the enemy, the Bureau of Mines, Department of the Interior, has now returned to its interrupted peace program, and during the week of Sept. 29 next will formally dedicate, to the best interests of humanity, its new million-dollar laboratories and workshops in Pittsburgh, Pa., with ceremonies which will be national in scope.

The use of reinforced concrete for the repair of masonry bridges, which through age, excessive traffic or other causes have decayed or been damaged, is now recognized by engineers in England as a very effective method and one which dispenses with the necessity of rebuilding. A number of England's highway bridges that for various reasons would have needed reconstruction have been made good by the employment of reinforced concrete.

As part of a nation-wide campaign to secure the naturalization of foreign-born employees, the Department of Labor, Washington, has asked all industries to question their employeès concerning their desire to become naturalized, or to complete their naturalization if they have taken out their first papers.

COMPRESSED AIR MAGAZINE

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COMPRESSED AIR MAGAZINE CO., PUBLISHERS, EASTON, PA.
Devoted to all useful applications of compressed air and to everything pneumatic
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W. L. SAUNDERS, *Editor*
FRANK RICHARDS, *Technical Editor* FRANCIS JUDSON TIETSORT, *Managing Editor*
CHARLES A. HIRSCHBERG, *Business Manager*

Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

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STOPPING WASTE AND LEAKAGE SAVES HALF OF THE AIR

AN INSTRUCTIVE lesson in compressed air economy may be learned from the experiences of the Bethlehem Shipbuilding Corporation, Ltd., at the Fore River yard. Operations had begun there with 150 to 160 riveting gangs, and in a few months the force had increased to 300 gangs, but even with the former number the air supply was often short, and the pressure would go down to 50 lbs., instead of the 80 or 90 which should have been maintained.

When the shortage had become critical, seriously delaying operations, a thorough and systematic investigation was started by direction of the general manager, Mr. S. W. WAKEMAN. A twelve-man patrol was sent out to find and stop leaks and the shops were policed. All leaky hose was doctored or discarded. Blowing snow off the work by compressed air was stopped. Posters in prominent places did effective educational work.

In a short time the air consumption, which had run up to 60 cu. ft. per min. per riveting gang, was brought down to nearly 30, and then to 25 or lower. On the biggest operating day, Aug. 1, 1918, there were 315 riveting gangs at work in the yard, yet the pressure held steadily up to 90 lbs.

Addition of two 5000 cu. ft. electric driven compressors increased the previous capacity of 12,600 cu. ft. per min. by piston displacement to a total of 33,600 cu. ft.

Before these new machines were put in, a 1000 cu. ft. compressor was hired, and later two 1700 cu. ft. machines were borrowed from the equipment built for the new Squantum plant. Except for these two temporary additions, however, the old installation had to carry the load. A year ago the air consumption ran up to 11,000,000 cu. ft. in 24 hours; the present consumption ranges from 8,000,000 to 9,000,000 cu. ft. in spite of a 50% increase in the number of gangs working.

THE AGE OF AIR BEGUN IN BOTH EUROPE AND AMERICA

ARRIVAL of the "Age of Air" was chronicled lately in the British press when the British Air Ministry announced that civilians might travel through England to Scotland, Ireland, and the Continent by seven great Air Ways. A decade ago such an event would have appeared impossible, we are reminded by *The Literary Digest,* but today Great Britain has the machines, the pilots, and the airdromes, while air routes are precisely laid out from Edinburgh to London, to Plymouth, and over other aerial bypaths.

We are truly living in a new era, one to cause wonder and to give pause to those occupied with the humdrum. The commercial, but domestic aerial era began earlier in the United States than in England and continental Europe, due of course to prohibitive wartime conditions abroad. We have had private passenger carrying for many months, and the aerial postal service, constantly being extended now, has become almost an old story to us. But the commercial dirigible airship has been neglected largely. World expansion of the fields of aerial travel, however, is coming on rapidly and customarily alert America will do well to look to its laurels. Notes of warning are being sounded by the commercial captains of America. We must not forget, in our development of the great American merchant marine, our aerial argosies, else we shall be outstripped in the international trade race. Aviation is no longer a plaything or merely a military service arm.

The Daily Mail, of London, foresees at no distant date such a development of air travel that for business or pleasure people will buy tickets for the Continent and India by air as naturally and readily as they now take them by steamer and train. As to the safety of air-travel, we are advised that the Air Ministry is responsible for the inspection of machines and the examination of pilots, and *The Daily Mail* avers that the public will look to it to see "that the new service is neither hampered by excessive regulation nor endangered by careless operation."

This new era in the history of the world, according to the Dublin *Freeman's Journal,* is as fateful as that which opened out when Stephenson completed his trial trip with the railway-engine ninety years ago, or when the good ship *Sirius* voyaged under steam from Cork to America. To the war the world owes "the conquest of the air," a phrase that was presumptuous a dozen years ago, but may now be used with propriety.

This Dublin daily says that in these latter days we have read of all sorts of citizens making flights, "Cabinet Ministers speeding through the air from London to Paris and back on affairs of state; Easter holidaymakers, on pleasure bent, flying from town to town in England, or, as two groups did, making a circuit of the United Kingdom." It is little wonder, consequently, that the announcement of the freeing of aviation for civilians has not caused any evident thrill, says *The Freeman's Journal,* which proceeds:

> In the rules under which flying must be conducted there must be wide-spread interest. They have been outlined by General Sykes, Controller-General of Civil Aviation. So far as the safety of the public and of the persons engaged in the management and control of machines is concerned they differ only from the regulations governing railways and sea-craft in having a greater degree of stringency. Pilots, navigators, and engineers must pass a medical test; every machine must be registered, and, before being registered, it must be thoroughly tested. The rules affecting passenger-cars provide for a definite load—there can be no 'strap-hanging' in the air; every car will be inspected before it sets out on its trip by a competent person other than the pilot; and woe betide the passenger who throws anything overboard, ballast—that is to say, fine sand—or water being the only matter that can be flung out during the trip.

In an announcement of the British Air Ministry we read that hitherto much of the progress in aviation has been due to war and war-conditions, with the result that at first the majority of machines used in civil aviation will be either actual war-models or war-models adapted, but—

> Types more suitable for pleasure and commercial work are already beginning to make their appearance, and for them, as has been the case with the earlier war-models, rigid care and supervision in regard to construction and air-worthiness will have to be insisted upon for the safety of the traveling public, and also the public which does not travel.
>
> For this duty the Air Ministry will continue to be responsible. It will not in any way hinder development by imposing inspection on inventions or purely experimental machines, but it will insist on the inspection and certification for general air-worthiness of any passenger-machine plying for hire. Not only the machine, but also the pilot who carries passengers and the airdrome where he lands will be liable to periodical inspection, and if they are not passed as fit the license is liable to be withdrawn.

This all sounds very business-like; it is almost prosy. On reading it, we may very well stop and consider our own case in America. It is not the province of our Army nor of our Navy air services to supervise commercial aviation, and accordingly we are glad to note that the National Foreign Trade Council and the recently held Sixth National Foreign Trade Convention have gone squarely on record favoring the establishment of a Department of Aeronautics by the United States Government, and the fullest and speediest possible commercial use of airship service. These declarations of sentiment were among the most significant and important results of the foreign trade convention held at Chicago. Nearly four-score leaders of American foreign trade enterprise presented a report containing this striking declaration:

> Realizing the unquestioned advantage of having the speediest possible mail and express service in enabling American enterprise to compete successfully in securing the specifications and requirements of our foreign contracts, this Convention urges Congressional consideration of suitable plans for developing aerial navigation. The establishment of the necessary aids to such navigation, the investigation and development of the fundamental principles of commercial aeronautics, the promotion of airship service to overseas countries are matters which demand the present establishment of a separate department of the Government.

This report was presented to the Convention by Mr. JAMES A. FARRELL, president of the United States Steel Corpoartion, who was chairman of the Convention Committee. Mr. ALBA B. JOHNSON of Philadelphia, president of the Baldwin Locomotive Works, presided over the Convention which unanimously ratified this committee report.

It had come to the attention of the Council that foreign nations, particularly Great Britain, were making painstaking and vigorous preparations for the most effective use of airship service in commercial enterprise. The Council had been made aware that our enterprising English friends were already procuring airship stations in other countries and were developing carefully considered plans to insure effective results by this means of communication in the immediate future.

The sequence to obtaining knowledge of what Great Britain was doing was the call upon our Government and upon American commercial enterprise to begin similar preparations on this side of the water, lest we find ourselves again outstripped by England as was the case in the development of her merchant marine, and in establishing coaling stations around the world.

The possibilities of the commercial use of airships were presented to the National Foreign Trade Convention by Lieutenant-Colonel HIRAM BINGHAM of the United States Aviation Service, who was in command for several months of the largest flying field of the world in France. The great audience in the Convention Hall, Chicago, was reported to have laughed at the announcement that Colonel BINGHAM would speak on "Aviation in Its Relation to Foreign Trade," but the speaker very quickly and completely convinced the audience, as was demonstrated by the prolonged and enthusiastic applause when he had finished his address.

"When you laughed about aviation in foreign trade," he said, "it reminded me of the laugh the captains of the clipper ships put up a hundred years ago when it was suggested that one could sail in an iron steamer."

> Most of you think of aviation as being something very interesting to college boys and people who do not care whether they break their necks breaking the world's record in automobiles, but of very little use to the export trade. As a flyer, I do not regard ordinary flying as any more dangerous than crossing New York in a taxicab. Of course when you get into stunt flying or military flying against an enemy, that is a very different matter.
>
> The proper use of aircraft to bring the manufacturers of the interior of the United States quickly in touch with the great shippers, thereby saving from one-third to one-half the usual time in receiving mail, specifications, blueprints, etc., can be easily understood by any of you. But the business of connecting ourselves with foreign countries by means of airships, in order to get quickly the specifications or blueprints that we need, in order to know what big business has got to deal with, what big contracts are going to depend on, is something that we shake our heads over when we consider it.

Colonel BINGHAM took up the subject of dirigibles and of helium gas, which is destined to alter the entire science and business of dirigible airships. Before the war helium gas cost $1,600 per cubic foot. In the course of the war it was discovered that helium could be extracted in a commercially feasible manner from the natural gases of Texas, Oklahoma and other states at a cost of ten cents a cubic foot. Helium, if used in our balloons on the western front, prior to the discovery of cheap production would have cost the Government thirty-six billion dollars; after the discovery, the cost of the gas for our European military needs would have been $200,000.

Helium is the lightest gas next to hydrogen, and has ninety-five per cent. of the lifting power of the latter. It is non-explosive and non-inflammable. When helium gas is utilized, the engine of an airship may be placed inside the balloon envelope. But when an explosive gas is used in the balloon, the high-power engine must be placed outside where it resists and makes all sorts of trouble, and where the engineer cannot get at it readily. But with a non-explosive gas the engine may be installed inside, and the engineer may be very comfortably located. The passengers can be inside without any danger that they will be brought down by some spark setting fire to the balloon envelope, causing the balloon to explode.

The army aviation expert stressed the fact that sometimes we Americans are not very far-sighted. After the great European war of 100 years ago, as he mentioned, we found that our clipper ships could sail faster than any other nation's ships, and so we pinned our faith to the clipper ship, and we laughed at England when she placed her faith in iron ships. Today we smile when we hear that Vickers Limited is building airships to connect up the distant capitals of the world with London, but it is true.

In a very few months, very quietly, they will have got to the strategic points along the east coast of South America, India, Africa and Australia, just as they got the strategic points for their coaling stations. A couple of generations ago they went out and got the best coaling stations, so that we, who followed later, found it difficult to operate our merchant marine, because naturally, the country that established the coaling stations had the preference.

Col. BINGHAM shot these words at the leaders of American foreign trade:

> Now, what I want to say is that you business men should get busy and realize what it means to have the big contracts that are going to come from Peking, Buenos Aires and the other distant capitals, with their specifications, blueprints, and all paraphernalia connected with them, and the men who know the game, brought in three or four days to London in Vickers air ships—dirigible balloons, when it will take you three or four weeks to get them to New York in your American steamships.
>
> How are you going to compete if you don't wake up to the necessity that the world of the future is going to depend on getting its mail and express rapidly by means of dirigible balloons, which are perfectly practicable, with helium—and we are the only country that has got cheap helium—making it a perfectly feasible proposition? But it depends upon having lighthouses for the balloons, ports, organizations, strategic points, so that the captains of these dirigibles won't have to go wandering around the world wondering where they are going to land, and who is going to take care of them, who is going to repair them, and who is going to give them the necessary gas, oil, helium, etc.?

We should let pass no opportunity to impress upon the Congress, now concerned so greatly with politics national and international, that there must be a quick awakening and the appointment of an Air Secretary at the head of a thorough-going commercial air department, or we shall be left far behind in the race and forced to copy our neighbors of greater foresight and enterprise. It is a case of coping with a situation of grave business moment, not one of playing with toys.

AVOCATIONAL WRITING FOR THE TECHNICAL PRESS

THE WORKMAN is worthy of his hire, but the man who does not derive joy from his work, who fails of a warming satisfaction in his service for others, is either misplaced in his vocation or has failed to grasp the American idea. The writer, whether for the popular or the technical press, has missed a proper conception of his duty and his privilege, it seems to us, unless he finds his reward beyond that of emolument, in the sense of having performed a service for the benefit of mankind.

This idea was discussed, insofar as technical writing was concerned, in the columns of our neighbor, *The American Machinist*, not long ago, and subsequently, Mr. G. R. SMITH of Pittsfield, Mass., a regular contributor to the publication, commented interestingly on his own experiences. He took the view that there was not only an adequate financial return for the small allotment of time devoted to technical writing as an avocation, but that there was the infinitely greater compensation in the feeling that one had served his fellow men.

"If by writing your experiences to your favorite technical journal," he says, "you can contribute a trifle to the sum total of mechanical knowledge in the world; if you can do something that is going to help your brother on the next bench, in the shop on the next street or on the other side of the world, your work is justified."

Allowing a modest average of three readers to each copy of COMPRESSED AIR MAGAZINE, there are a total of nearly fifty thousand pairs of eyes that scan its columns each month. We like to think that the carefully selected material they find contained in the publication is an aid and an inspiration to achievement, and also, that the work of our staff of contributors is appreciated. On the side of the contributor, as Mr. SMITH notes, his work is read by thousands of his fellow countrymen in the United States, and also by engineers and mechanics in all parts of Europe, Africa and Asia. "It is possible that while your words are holding the interest of the English factory-manager in his London club, the native mechanic in India, and the mining engineer in the Transvaal (this depends somewhat on how interestingly you write, you know), the same words are perhaps being puzzled out by a machine shop foreman in Greenland, or by a husky, dusky apprentice in the Solomon Islands."

Great credit is due most writers on technical subjects because of the fact that they work at their general source of income in the daylight hours of business and are obliged to dedicate their evenings and other leisure time to their avocational preparation of articles and books. They are entitled, one is obliged to conclude, to all they obtain in payment of their work, whether in shekals or in satisfaction.

We are threatened with considerable unrest industrially from the labor standpoint in the remaining half year of 1919, according to the present outlook. Large employers of labor in many lines may have to face difficulties. The "social injustice" of which the Bolshevist, the member of the I. W. W., and the anarchist bomb-thrower, complains, is of course an imaginary thing, born of ignorance and perversity due to false teachings to which such people for a long period have been giving their ears and eyes.

In the minds of the disaffected there has been effaced, if it ever existed, any understanding of American institutions, or a comprehension of the fact that this is a land of liberty protected by law. Minds have been filled full of the hate doctrines emanating from MARX and his disciples. Many have resented and fought against a real understanding, because born enemies of society.

Too many people in this country have been segregated and shut off from Americanism; multitudes of persons in this land of the free do not know what is going on about them. They get their notions only from those who teach false doctrines, from foreign language newspapers that are still permitted to flourish while telling their readers that they are the victims of oppression, that capital is their enemy, that our Government is a tyrant.

Are we not, as a nation, derelict in our duty in that we have not substituted the light of truth and reason for the incitements to discontent and violence that have been absorbed by our guests of alien origin?

The best minds in government and business are now engaged upon the problem of grappling with the enemies of organized society and preventing the spread of their pernicious and false beliefs. It is to be hoped in the years of reconstruction that we shall approach a solution of these problems.

Editors, COMPRESSED AIR MAGAZINE,
Bowling Green Building,
New York City.

DEAR SIRS: We wish to congratulate you upon the June issue of the COMPRESSED AIR MAGAZINE. It is quite a work of art. We should like to obtain several extra copies of this issue.

Yours very truly,
U. S. & CUBAN ALLIED WKS. ENG. CORP.,
50 Broad St., New York.
By P. B. Streander, Compressor Dept.,
(Blaisdell Machinery Co.).

Buenos Aires

Our very own Scherazade tells us of an incident attending the testing of a very high pressure air compressor for the navy at the Painted Post works of the Ingersoll-Rand Company, in course of which process air was forced into wrought steel bottles at 3,000 pounds to the square inch. A young engineer, a Cornell man, just back from overseas service with the A. E. F., was explaining the apparatus to a visitor, who inquired artlessly:

"Say, what would happen if the pressure on these bottles became too great? Supposing, just supposing, the safety devices should fail to work?"

The ex-soldier grinned. "That reminds me of a question a doughboy asked of his top sergeant in the Argonne Forest battle. There had been severe fighting and the Yanks, after winning their objective, were resting for an hour.

"'Well, sergeant,' queried the doughboy, 'where do we go from here?'

"'Huh,' replied the sergeant, 'that all depends on your religious convictions!'"

W. H. (Wilhelm Hohenzollern?) Kaiser, according to our friend D. C. G., is located in the *Guardian* building in Cleveland, Ohio, which fact will probably fascinate Don Marquis and F. P. A., and stir the State Department.

YOUR NOSE KNOWS!*

Knows he, who never took a whiff,
  Nosey! the pleasure hence which flows?
Knows he the titillating joys
  Which my nose knows
Oh, nose! I am as proud of thee,
  As any mountain of its snows;
I gaze on thee, and feel that joy—
  A Roman knows!

---

*Dedicated to the tobacco ad writer with the usual to Alfred Crowquill.

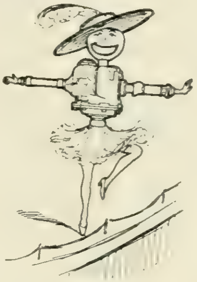
Husband (reading of the exploits of the NC-4)—They couldn't induce *me* to go up in one of those airplanes.

His Better ¾—Maybe not, my love, but you will go up in the air all right when you get the bills for my new summer dresses!

Short was the passage through this vale of care,
  By concrete roads that autos used to wend;
But now we travel by the route of air—
  A dead engine! we reach the journey's end!

Paying for Free Ads

Dear Balmy:—I am apprehensive that the printers have mis-spelled your first name, as appended to the "Buenos Aires" column, hence my spelling. I am sending you herewith a sketchy little thing showing the applause of Little David for Compressed Air "Mag," which is sent in appreciation of the mention of Little David air hammers in your columns in two late issues. Yours in the faith.



Bunny,
Ingersoll-Rand Co., New York.

Rockabye baby on the tree top,
When the wind blows the airplane will rock.
Daddy has climbed to the dark earth below
To get some more gas so the motor will go.

Rockabye, rockabye, mother is here,
The clouds are thy blankets, the moon hovers near,
The watch stars are guarding to save thee from harm,
And the vacuum bottle will keep thy milk warm.
—Josephine Hemsley in N. Y. *Evening Sun* Dial.

Making, Not Filling, Vacuums

When Mr. Herbert Hoover was paged on board the *Aquitania* on the occasion of a recent arrival of the steamship at New York, the reporters and moving picture photographers obtained a response from a gentleman who explained:

"I'm Herbert Hoover all right, but I create vacuums, while the man you are looking for fills them."

This Mr. Hoover happened to be a manufacturer of vacuum cleaners.

For every evil under the sun
There is a remedy, or there's none;
If there is one, try and find it,
If there's not, then never mind it!

Airy fancies and rarified and lighter than gossamer wheezes, even if less than one atmosphere, although we draw the line at a vacuum, will be welcomed from readers for publication in this plinth of persiflage. Even technical folks, including solemn engineers, have their reactions. They are entitled to an occasional change of diet so all hands must help feed the animals.

Bawmie Inthebean.

Books and Writers

HAND BOOK OF FIRE PROTECTION, by Everett U. Crosby, Henry A. Fiske and H. Walter Forster. Sixth edition, 1919. Indexed and containing miscellaneous tables and charts. Illustrated with photographs and drawings. Price, $4 net. New York: D. Van Nostrand Company.

THE FIRST fire protection handbook in the English language was issued twenty-two years ago by Mr. Crosby and it has stood through subsequent editions down to the new one lately issued as one of the most authoritative treatises on the subject. This sixth edition has been spruced up materially with the addition of chapters that bring various timely subjects down to date, together with additions to and revisions of former chapters.

In their prefatory remarks the authors call attention to the "national disgrace" of fires causing an annual direct loss to the country of a quarter of a billion of dollars. Disgrace attaches to the statistical fact in that very large measure fires are preventable by relatively simple methods and at a cost in proportion to the benefits to be gained. With too many folk fire prevention is a case of locking the stable door after old Dobbin is stolen. It is as difficult, even today, to get certain factory owners to provide against loss of life and property by fire as it was to get steamship owners to install wireless telegraph ten years ago.

With some property owners, who keep just inside the law and sometimes manage to shade that considerably, their attitude toward fire is their attitude toward lightning; it can never hit them! Indifference, ignorance and carelessness go hand in hand with heavy fire losses. It is not necessary to consider the criminal phases.

The C-F-F Hand Book is a liberal education in the entire subject of prevention for any business man or for any property owner, who may have the slightest interest in safeguarding life, his finances, and his reputation for intelligence. By the expenditure of a few dollars and a few hours of time he can absorb all of the information he needs to enable him to act in the premises for his material and moral benefit. In front of him will be spread the results of lifetimes of experiment and practice by experts.

There is encouragement in the increasing systematic attention being given to fire protection by individual plants and by public fire departments in most of our towns and cities. In the preparation of the sixth edition of the book under discussion the needs of such organizations have been carefully considered by the authors, as well as have the requirements of insurance engineers and inspectors, for whom the work has long served as a standard reference authority.

Chapters are devoted to the fundamental principles of fire protection and to considering it as an engineering science. The relation of accident prevention to fire prevention is clearly shown and the causes of fires in all the industries and walks of life are explained in great detail. The many dangerous substances found in manufacturing plants are noted with appropriate comment and warnings.

The subject is so minutely handled and the work is so complete in every direction that even to mention the subjects covered would require greater space than can be afforded it here. Printed on very thin and high quality "bible" paper, its 800 pages comprise an encyclopaedia in handbook size.

We are glad to congratulate the authors and publishers on so excellent a bit of technical bookmaking, and we predict for the sixth edition the greatest sale it has ever enjoyed.

SOLVING ADVERTISING PROBLEMS, by Advertising Artists, Inc., New York. Illustrated. Distributed by Brentano's. Price, $1.50 net.

ADVERTISING in any of its forms is a much-discussed subject these days the while the experts praise this and damn that. All summed up, the popular estimate of advertising has become a good deal like the old Kentucky description of whiskey: all of it is good, but some of it is better. Our own private opinion of advertising is, that to produce the desired results the advertiser need only employ common sense and good taste, and that the finer shades of technic in the preparation of copy are often love's labor lost. Not that we would discourage finesse, "art" or the employment of skilled brains in the preparation of ad copy; far from it. An editorial in the July issue of COMPRESSED AIR MAGAZINE contained some of the delectable views of Professor Parsons on technical publicity, and art in connection therewith, that greatly diverted our manufacturer readers.

"Solving Advertising Problems" is a little book, which must have cost several thousand dollars to produce, that has just been issued by a popular firm of advertising artists in New York. It contains some 250 reproductions of sample advertising posters and designs with running comment in type. These designs are said to have been unusually successful in helping the sales of a wide variety of merchandise for general consumption.

Mr. Harry A. Weissberger, who has achieved quite a reputation as a lecturer on advertising, Mr. William G. Sesser and Mr. Alfred J. Silberstein, have collaborated in turning out the book, which should prove of considerable interest and value to advertising managers in many fields. They declare, with truth, that the value of an advertising design lies in its worth as a selling idea, which, if properly executed, is worthy of the valuable space it occupies on the advertising page. Advertising space, incidentally, is frequently more costly on a square foot basis than New York City real estate, and is sold over and over again, whereas real estate usually stays sold, for a few years at least.

Artwork in advertising, whether it be in connection with an air compressor or a baby carriage, has just one duty: to sell something. It may be employed for immediate sales, or, its object may be to create prestige for the advertiser so that he will be assured of sales over a long period of time—the Ivory soap kind of advertising. Artwork must *sell* to the public, not of necessity *please* the advertiser.

There is fact in the commentary that many a brilliant selling idea, or at least considered such by recognized experts, has been shelved just because it did not hit the *fancy* of the advertiser. On the other hand who has not seen big successes achieved by the advertiser who was wise enough to disregard his personal taste and let cold business judgment in advertising dictate the selection of ideas?

American ad copy, including art designs to illustrate it, is conceded to be the most effective used anywhere in the world. The specimens of advertising illustration work afforded in "Solving Advertising Art Problems" may contribute somewhat to the general development and improvement of art work in advertising, and this is the hope of the publishers of the book.

TRAINING FOR THE ELECTRIC RAILWAY BUSINESS, by C. B. Fairchild, Jr. Nine illustrations and three charts. Price, cloth $1.50 net. Philadelphia and London: J. B. Lippincott Company.

THERE ARE in the United States about two thousand electric railway companies, with a capitalization of something over five billion dollars and paying annual salaries and wages of more than three hundred million dollars. To the young man at the threshold of his life work the electric railway industry therefore presents a career of almost unlimited opportunities, depending upon his own ability, and his understanding of the problems involved in this vast and growing business.

In "Training for the Electric Railway Business," (just added to the Lippincott Training Series), these problems have been simplified and described by a practical railroad man, C. B. Fairchild, Jr., Executive Assistant to the Philadelphia Rapid Transit Company, with the cooperation and oversight of T. E. Mitten, Chairman of the Executive Committee of the same great organization.

How is this great business organized? Mr. Fairchild has charted it so that the relations of each part to the whole are readily understood. What are the officers of the company, and the duties of each? What must a man know to hold such positions successfully? And how is he to gain this knowledge?

The answers to these questions are definite and clear. The executive and transportation, engineering, administrative and miscellaneous functions performed by the army of employes, are each presented and discussed. The general and specific qualifications for the business, and how best to acquire them, are given in detail.

While there is no doubt that a thorough technical education is an advantage to the young man just beginning his career in this business, "the fact can not be denied," says the author, "that there are today many successful men occupying executive positions with electric railway companies, including the heads of engineering departments, who have not had technical educations." And he indicates some of the methods by which the ambitious man who cannot obtain a regular education, may overcome this handicap while occupied with the duties of whatever position he may have obtained on the road. His daily labors give him a practical advantage in familiarizing him with concrete knowledge, if he will supplement this with outside reading and study.

Primarily intended for the young man seeking a vocation, the book will not only meet his needs admirably, but will prove of interest to the older student of affairs who likes to delve into the business problems of "the other fellow," (perhaps gaining some enlightenment for his own), and to the investor and the general public, who want to know how this business which so nearly concerns their comfort and welfare is managed. This is an authoritative presentation of the subject, from men who are counted among the best known electric railway men in the country.

American Spiral Pipe Works, Chicago, has recently issued a "Production Book" containing many photographic reproductions of various lines of manufacture. The announcement states that this book is particularly interesting from an engineering and industrial standpoint and clearly illustrates the advancement in the manufacture of corrugated steel furnaces, large-diameter lap-welded steel pipe, spiral riveted pipe, forged-steel flanges and forged-steel boiler nozzles. Copy of this book will be mailed by the Pipe Works' publicity department upon request.

SEVEN MILLION WORKERS NEED TRAINING. Bulletin No. 9, U. S. Training Service Department of Labor. Washington: Government Printing Office.

UPWARDS of 7,000,000 workers in this country have not had opportunity to become properly trained in their tasks, according to the U. S. Training Service, of the Department of Labor, the function of which is to promote industrial training in manufacturing plants in this country. The system of training which the Training Service advocates is one of upgrading workers by extending their knowledge of processes and increasing their skill. It devotes itself to raising the average output of poor and mediocre and fitting promising individuals for promotion.

These and many other facts equally pertinent to reconstruction problems, are set forth in a vest pocket bulletin entitled "Seven Million Candidates for Training" issued by the Training Service. This pamphlet shows that part-time and continuation training, splendid as it is, does not reach the great majority of the 7,000,000 workers referred to.

They are already at their jobs and because of economic necessity cannot sacrifice time or wages to attend continuation classes. To meet this situation training departments in the shops and factories, maintained at the employers' expense, are urged as the most practical remedy. The publication referred to maintains that the training department idea has already demonstrated its great value for peace-time industry, and that the number of firms introducing training in their plants is growing week by week.

The task of the government's Training Service is to provide interested manufacturers with expert advice in planning their training departments and to supply them with carefully prepared training courses. The bulletin referred to above and others on this subject can be had free of charge by addressing the U. S. Training Service, care of the Department of Labor at Washington.

The Metal & Thermit Corporation, New York, has issued a folder entitled "How Thermit Healed My Broken Jaw," which illustrates the operations involved in making a thermit weld on the 13½-ton broken upper jaw of an alligator shear used by Joseph Joseph & Bros. Co., Modens, Penn. The break welded was 80 in. in length and varied from 4½ to 23 in. in thickness.

ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES BY THE SLOPE DEFLECTION METHOD, by W. M. Wilson, F. E. Richart and Camillo Weiss. Bulletin No. 108. Champaign, Ills.: University of Illinois, Engineering Experiment Station, C. R. Richards, Director.

IN RECENT years rectangular steel frames with riveted joints have been used, and many types of monolithic reinforced concrete frames have been developed. The use of statically indeterminate stresses cannot, accordingly, always be avoided. Structures are frequently made of an indeterminate type to secure economy of material. It is felt that analyses of statically indeterminate structures are desirable since such information will do much to inspire confidence in the reliability and in the economy of such structures.

An investigation of statically indeterminate structures has been conducted by the Engineering Experiment Station of the University of Illinois to obtain a convenient method of analyzing the moments, stresses and deflections for a number of typical structures. The analyses were based upon the assumptions that the connections are perfectly rigid, that the length of a member of a rectangular frame is not changed by axial stress and that the shearing deformation is zero.

The method used in the analyses and the equations derived are published in Bulletin 108 entitled, "Analysis of Statically Indeterminate Structures by the Slope Deflection Method, by W. M. Wilson, F. E. Richart and Camillo Weiss. The method has been explained in sufficient detail to enable the designing engineer to use it in the solution of his problems.

It is believed that the fundamental principles presented may be readily coördinated with the ordinary principles of mechanics so that the more complex and even the simpler problems may be studied from a new viewpoint.

We are requested to announce that copies of Bulletin 108 may be had without charge by addressing the Engineering Experiment Station, Urbana, Illinois.

PUBLICATIONS RECEIVED

RAW MATERIAL, first two issues of a new monthly magazine devoted to metals. R. L. Herrick, editor. Published by the Gage Publishing Co., Inc.

114 Liberty St., New York. An attractive and useful magazine of its class, letterpress good; technical articles of value.

SPRAGUE ADJUSTABLE LOOP SYSTEM, being Bulletin No. 48,713, describing Overhead Material Handling Machinery for Terminal Sheds. Issued by the Sprague Electric Works of the General Electric Company. Illustrated with half-tones and drawings.

SPRAGUE ELECTRIC DYNAMOMETERS, being Bulletin No. 48,701-A, superseding Bulletin No. 48,701. A comprehensive and authoritative description of standard laboratory equipment for the testing of internal combustion engines by manufacturers, technical schools and U. S. Government experiment stations. Illustrated with excellent half-tone illustrations. Issued by the Sprague Electric Works of the General Electric Company.

AMERICAN EXPORTS OF AIR COMPRESSING MACHINERY

The Division of Statistics of the Bureau of Foreign and Domestic Commerce, Department of Commerce, has provided the following figures on United States exports of air compressing machinery for the months of March and April, 1919. These statistics will be published regularly hereafter in these columns through the courtesy of the Division of Statistics:

MARCH

Countries	*Dollars*
Denmark	$345
France	2,125
Norway	4,898
Spain	66,667
England	19,679
Scotland	2,495
Canada	9,449
Nicaragua	17
Mexico	2,205
Cuba	9,504
Argentina	2,437
Brazil	12,327
Chile	7,045
Peru	1,344
Uruguay	491
China	12,693
Dutch East Indies	35,360
Japan	57,886
Australia	1,624
Philippine Islands	1,065
British South Africa	455
Total	$250,111

APRIL

Countries.	*Dollars.*
Belgium	9,609
France	27,401
Italy	108
Netherlands	2,016
Norway	21,891
Spain	34,775
Sweden	47
England	56,371
Scotland	1,994
Ireland	954
Canada	14,404
Panama	26
Salvador	277
Mexico	6,417
Newfoundland and Labrador	445
Cuba	9,365
Bolivia	182
Brazil	8,296
Chile	16,813
Colombia	163
Ecuador	166
British Guiana	1,699
Peru	428
Venezuela	80
British India	5,986
Dutch East Indies	16,461
Japan	49,616
Russia in Asia	6,750
Australia	217
New Zealand	1,490
Philippine Islands	190
Egypt	240
Total	$294,877

At a meeting of the board of directors of the National Association of Manufacturers, held in the Waldorf-Astoria Hotel, New York City, following the 24th annual convention of the association, the following officers were elected: President, Stephen C. Mason; treasurer, Henry Abbott; general manager and assistant treasurer, J. Philip Bird; secretary, George S. Boudinot.

* * * *

The American Graphite Co., Ticonderoga, N. Y., a subsidiary of the Joseph Dixon Crucible Co., Jersey City, has the new office of assistant secretary and assistant treasurer, and has elected William Koester to fill it. At the recent annual meeting all directors and officers of both companies were re-elected.

* * * *

William S. Murray, for many years chief electrical engineer of the New York, New Haven & Hartford Railroad and recently president of the Hoosatonic Power Company, which supplies power to part of the lines of the Connecticut Company, has opened an office as consulting engineer in New York.

Survey of the Technical Field

Edited by FRANK RICHARDS

RAY OIL BURNER

For the satisfactory burning of fuel oil it is imperative that the oil be perfectly atomized and that it be mixed with the right quantity of air to produce complete combustion. In the burner here illustrated, devised by W. S. Ray, of San Francisco, the air is atomized in an open cup, lying horizontally, and then air is forced at high velocity around the cup and in a direction away from the cup.

In this way sufficient air is introduced for proper combustion and also enough to direct the fire into the fire-box. The air leaving the blower would naturally be turning in the same direction as the atomizer, thereby causing the fire to be unsteady and with a tendency to throw the oil on all sides of the fire-box, but this is overcome by the insertion of guide rooms in a nozzle surrounding the atomizer, and they divert the air from a revolving motion to a straight path.

The Ray oil burner employs a Westinghouse totally enclosed motor. The hollow shaft of this motor has been extended to permit the worm gear to be fastened to the center of the shaft, and the blower and atomizer are attached to the end opposite the motor. This permits the centering of the bearing on the shafts. A ball bearing is used at each side of the worm gear. This gear is encased in a bearing with an oil well at the base, giving the two bearings a splash feed which is positive and precludes the danger of either under-oiling or over-oiling.

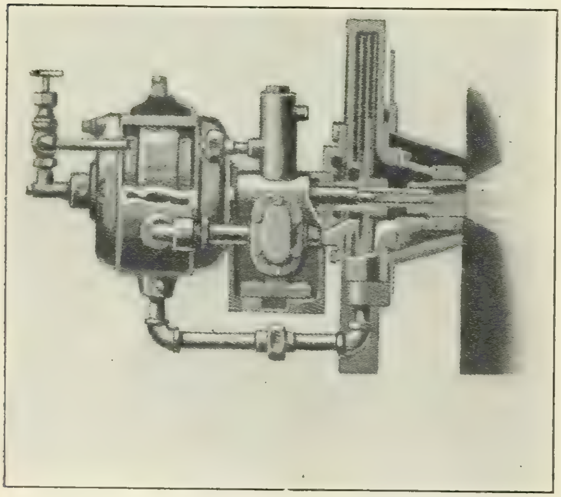


FIG. 1—SECTIONAL VIEW OF BURNER.

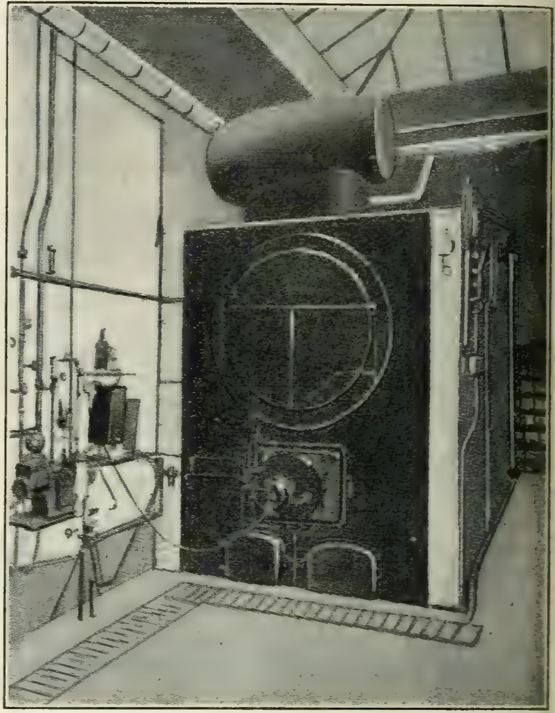


FIG. 2—BURNER APPLIED TO 150 H.P. BOILER.

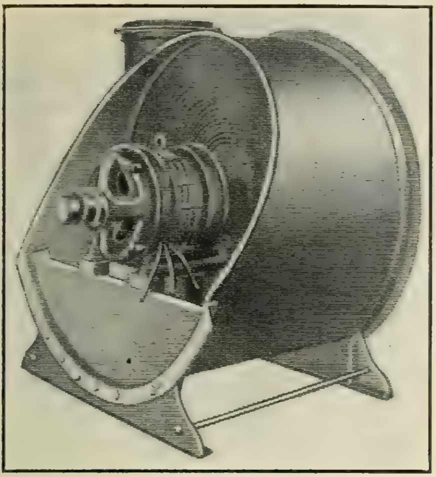
Fuel oil as low as 14 gravity can be burned successfully, without smoke, soot or dirt, in fireboxes of all types where high heat is required.

It needs not be said in connection with this burner that, in addition to the saving of fuel cost, there is an additional saving in the cost of attendants. To burn coal requires attendants constantly on the job 24 hours a day, whereas one man can supervise a large number of oil burners.

TURBO-COMPRESSOR FOR CUPOLA SERVICE

The half-tone shows a new turbo-compressor or blower built by the Spencer Turbine Cleaner Company, Hartford, Ct., principally for cupola blowing. It is a direct connected, self-contained unit, running at the unusually low speed of 1750 revolutions per minute, making very little noise and delivering 1800 cu. ft. of free air per minute at pressures up to 1½ pounds.

The illustration shows the motor, as connected. The power consumption is low at all loads, but is always directly proportioned to the volume of air



delivered, so that it is practically as efficient under light volume as when at full capacity. It is provided with a Spencer adjustable blast gate by means of which the volume delivered may be easily adjusted and regulated.

UTILITY PRESSURE AND VACUUM PUMP

We here illustrate and offer a brief description of an ingenious and interesting air compressor and vacuum pump built by the Utility Compressor Company, Detroit. The half tone, Fig. 1, shows the complete motor driven machine, and Fig. 2 is a section of the compressor portion of a machine of somewhat different design but embodying the same principle of operation. There are 8 cylinders, single acting, 1 in. dia., arranged in a circle, the pistons having a strike of $1\ {}^{5}/_{16}$ in. and their connecting rods being attached to a rocker or wobbling disk pivoted on a central universal joint and rotated by a single crank. There are thus eight piston strokes per revolution of the crank, and at 420 revolutions per minute, or 3360 piston strokes the piston displacement is 2 cubic feet per min., rather a toy affair after all. It is claimed that pressures up to 300 lb. may be obtained, or a vacuum of 28½ in. of mercury. There is one discharge valve with a very slight lift for each cylinder, and the intake is through a small aperture in the side of the cylinder which is uncovered when the piston is at the termination of its outward movement.

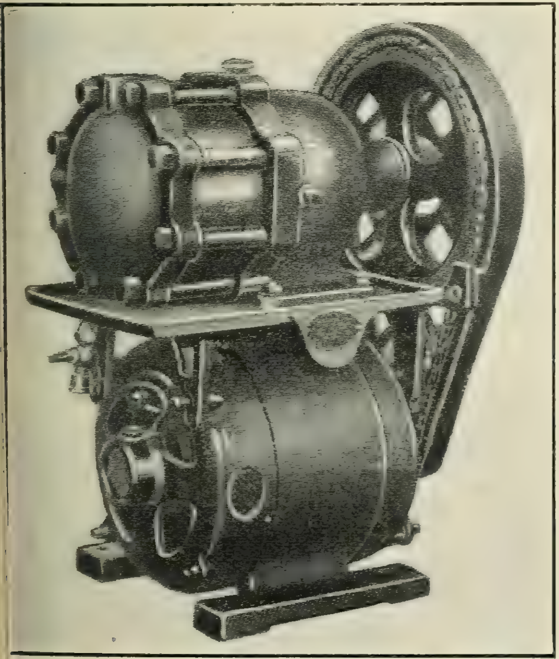


FIG. 1—COMPRESSOR AND MOTOR COMPLETE.

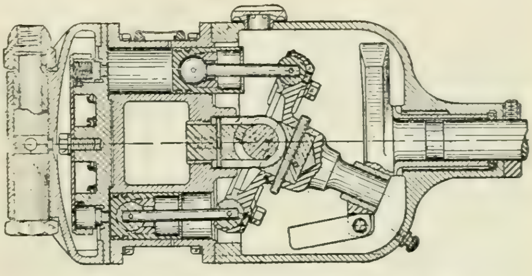


FIG. 2—SECTION OF COMPRESSOR.

A COMPRESSED AIR LINE AS AN ENGINEERING WATER LINE

At the shipbuilding plant of the Beaumont Shipbuilding & Dry Dock Company, Beaumont, Tex., which is piped throughout for compressed air, the main air line is connected directly with the water line. In the connecting pipe there is a stop valve which normally is stopped tight. In case of fire this valve is opened at once and water under full pressure is available at every point.

H. Lad. Landau, formerly General Sales Manager of the amalgamated companies of Rownson, Drew & Clydesdale and the W. J. Crouch Company, has joined the organization of Messrs. Victor E. Karminski & Co., Inc., No. 291 Broadway, New York, as Vice-President in charge of sales. Mr. Landau continues in the same line that has engaged his attention for years, that of marketing iron and steel products in foreign countries.

CONFIDENTIAL EMPLOYMENT BUREAU

NOTE—Advertisements under either of the classifications below will be numbered in the order of receipt and published free of charge, for the benefit of readers, in the next issue after date. All applications for the use of this convenience should be directed, "Confidential Employment Bureau," Compressed Air Magazine, Bowling Green Building, New York City. Replies to advertisements will be forwarded to the person or persons concerned.

HELP WANTED

No. 421—First class head mining captain wanted for Northern Peninsula of Michigan. None but a seasoned man need apply. Write at once to Bureau, giving particulars.

No. 422—Tunnel man familiar with drills and air machinery and speaking Spanish wanted for mine on west coast of South America. Climate good. Fare paid from New York. Contract for three years.

No. 423—Two good rock drillers, familiar Ingersoll-Rand equipment, required by Northern Michigan mine. State experience.

No. 424—Assistant mine superintendent wanted for Arizona. House furnished, rent free. Give past experience and salary expected.

No. 425—Pneumatic tool concern requires several expert machinists and lathe operators. Particulars regarding applicants required.

POSITIONS WANTED

No. 847—An educated man of wide experience as master mechanic, chief engineer and electrician, is open for engagement. Wants $4,000.

No. 848—Drill operator, age 32, reliable, wants steady place in Middle West, Illinois or Michigan preferred.

No. 849—Practical miner, familiar all air tools, wants job on South American West Coast. Unmarried, at present employed, but seeks change for experience.

* * * *

W. T. Walker, formerly of the Walker-Weiss Axle Co., Flint, Mich., has been elected president and general manager of the M. & S. Corporation, whose business was recently moved from Detroit to Cleveland. L. O. Haskins, formerly with the O. & S. Bearing Co., Detroit, has been appointed director of sales and advertising.

* * * *

W. H. Williams, general sales manager of the Hart-Parr Co., for several years, has accepted the position of sales manager of the Eagle Tractor Co., Appleton, Wis.

* * * *

Theodore E. Butler, for the last 20 years manager of the London office of the Whitman & Barnes Manufacturing Co., recently visited the Akron twist-drill and reamer factory and the Chicago wrench and drop-forge plant. Mr. Butler had not visited this country for five years prior to his recent trip. His office and salesrooms are located in American House, at No. 139 Queen Victoria St., London, E. C. In Akron, Mr. Butler was guest at a dinner given by the company, many business men attending. He returned to London.

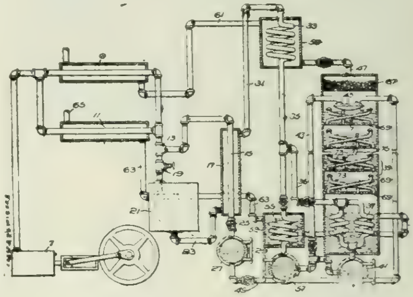
Latest U. S. Patents

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MAY 20

1,303,893. AIR-PRESSURE REGULATOR FOR PNEUMATIC TIRES. George W. Haskins and Earle H. Kellogg, Lovell, Okla.

1,304,027. METHOD OF SEPARATING MIXED GAS. Charles F. Crommett, Malden, Mass.



PATENT NO. 1,304,027.

1. A process of separating a mixed gas, as air, comprising the following steps:—compressing and cooling the mixed gas, expanding a portion thereof, liquefying the remainder by thermal contact with the expanded portion, thereafter cooling the expanded gas by the waste gases or vapors of the rectification process about to be referred to, liquefying the cooled gas by evaporating the liquid resulting from the rectification process, and effecting rectification by causing both quantities of liquefied gas to descend in countercurrent to the gases or vapors arising from such evaporation.

1,304,046. ROTARY PUMP OR BLOWER. Johannes Hinsch, Spandau, near Berlin, Germany.

1,304,123. DUST-SEPARATOR. George Tremblay and Joseph N. Dufour, Chicoutimi, Quebec, Canada.

1,304,162. AIR-PRESSURE GOVERNOR FOR AIR-BRAKE SYSTEMS. John W. De Schamps, Muskogee, Okla.

1,304,182. APPARATUS FOR DRYING MATERIALS. Harry E. Hollister, Irvington, N. J.

1,304,198. TORCH. Carl J. Nyquist, Chicago, Ill.

1,304,262. PNEUMATIC SHEET-FEEDER. Carl E. Christophel, Pearl River, N. Y.

1,.304,280. MILKING APPARATUS. Reuben B. Disbrow, St. Paul, Minn.

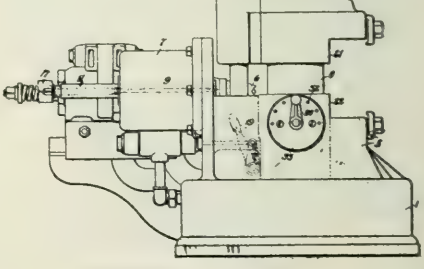
1,304,313. APPARATUS FOR RAISING LIQUIDS. Joseph Higginson and Hubert Arundel, Stockport, England.

1,304,280. WASTE-FUEL BURNER. Walter Jacob Santmyer, Seattle, Wash.

1,304,411. FLUID-OPERATED PUMPING MECHANISM. Stephen James Tobin, Menomonie, Wis.

1,304,439. AIR-COMPRESSOR. Cecil C. Yznaga, Sebastian, Tex.

1,304,459. DRILL-SHARPENER. Jesse Ditson, Littleton, Colo.



PATENT NO. 1,304,459.

1,304,523. ROCK-DRILL. Albert Ball and Thomas Officer, Claremont, N. H.

1,304,524. CHANNELING-MACHINE. Henry H. Mercer, Claremont, N. H.

COMPRESSED AIR MAGAZINE

Vol. XXIV SEPTEMBER, 1919 No. IX

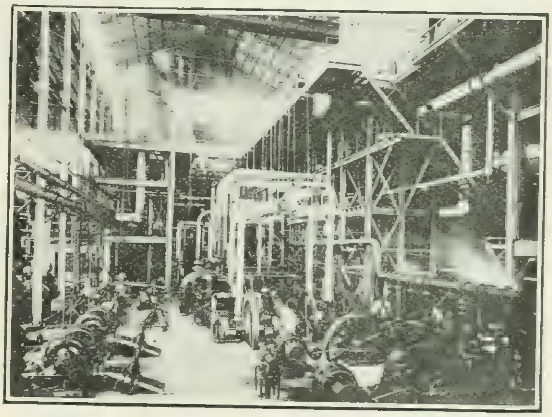
Compressed Air in Raw Sugar Factories

By *FRANCIS JUDSON TIETSORT*

THE AUGUST issue of COMPRESSED AIR MAGAZINE contained two very useful and interesting articles on the employments of air in the sugar industries, one by Mr. W. A. Becker, who described practice in both cane and beet factories, and the other by Mr. G. A. Meyer, whose observations concerned themselves with the air lift as employed in beet factories. These subjects are of growing interest to sugar house engineers and we are therefore glad of the opportunity to present further data which we have obtained through the courteous coöperation of the Honolulu Iron Works Company and the Krajewski-Pesant division of the United States and Cuban Allied Works Engineering Corporation.

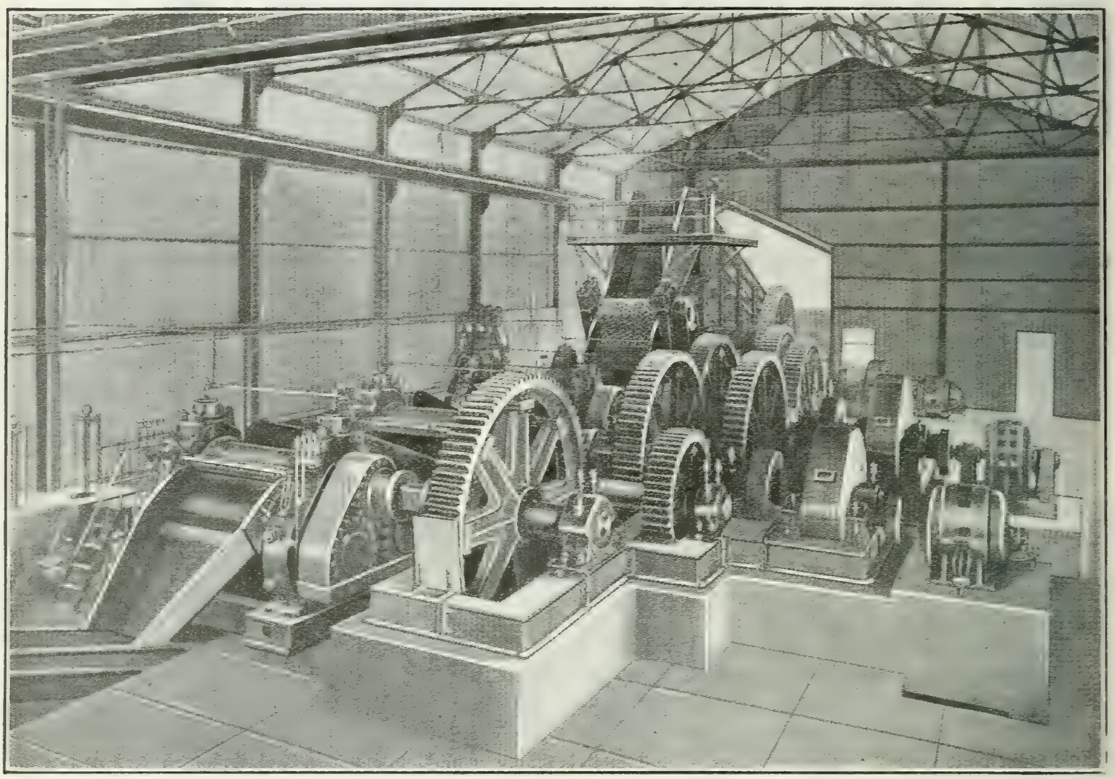
We have likewise been enabled to procure from these companies the illustrations accompanying this article, which will give any unversed reader a comprehensive idea of modern installations of raw sugar production equipment, with the exception of minor details.

Even for a layman the newtime sugar central, when in operation during the "campaign," or grinding season, is a thing of fascination and consuming interest. From the spectacular standpoint raw sugar making has no rival among the picturesque industries of the tropics. Two years ago the writer completed a tour of visitations among some three-score West Indian centrals, inspecting among others, the famous Guanica Central at Ensenada, Puerto Rico, owned by the South Puerto Rico Sugar Company. The plant of this company, which directly and indirectly employs some 30,000 persons during the grinding season, is rated as the largest cane raw sugar factory in the world in point of capacity, but second in production, inasmuch as it grinds on the average during only six months of the year, as against nine months' grinding by its great Cuban rival.



INTERIOR VIEW OF A CANE SUGAR FACTORY, SHOWING TWO BELT-DRIVEN IMPERIAL TYPE XB INGERSOLL-RAND VACUUM PUMPS IN THE RIGHT FOREGROUND.

With the shutting off of the production and sale of alcoholic beverages in the United States there has already been a noticeable increase in sugar consumption, for well known physiological reasons and the public as a whole has had an added interest in sugar, the dearth or absence of which was one of the material hardships for Europeans in the course of the war. The writer was instrumental in having moving pictures made of Guanica Central in operation, these pictures having proved of the greatest popular interest for large audiences in Carnegie Hall, New York, and in other metropolitan cities throughout the United States when displayed and explained by Mr. Newman of "Newman Traveltalks" fame. Moving pictures of sugar machinery in action



MILLING PLANT OF THE CENTRAL AMERICA IN CUBA, ELECTRICALLY DRIVEN AND SET IN CONCRETE FOUNDATIONS. THIS EQUIPMENT CONSISTS OF A 34″x78″ KRAJEWSKI CRUSHER DRIVEN BY A 150 H. P. ELECTRIC MOTOR; A 36″x78″ KRAJEWSKI NINE-ROLLER MILL, DRIVEN BY A 500 H. P. ELECTRIC MOTOR; AND A 36″x78″ KRAJEWSKI THREE-ROLLER MILL, DRIVEN BY A 250 H. P. ELECTRIC MOTOR.

taken in Cuba by the General Electric Company and displayed in theatres throughout the country also have proved of interest to hundreds of thousands of people who knew nothing, of course, about the technical side of sugar-making, but who were nevertheless enabled to obtain a very good insight into how cane was converted into sugar.

Guanica Central is a collossal enterprise. Five thousand tons of cane a day is ground when the milling plants are working at full capacity. Production is on a highly scientific basis, chemistry playing a large part. Every carload of cane that comes into the central over the company's railway lines from the thousands of acres of cane fields, is weighed, a note made of the car number and the field of its origin and the juice of the cane in that car is tested in the laboratory. If the tests show that the cane is not ripe enough, cutting in the field from which it came is stopped. If it lacks fertilizer, this failing is remedied in due course. The exhaustive story in the records of a crop indicate to what an extent science has taken the guessing out of sugar production.

Molasses that the sugar centrals formerly threw away has for a number of recent years brought a good price from the industrial alcohol makers. The burning of the *bagasse* saves on coal and oil consumption in the furnaces. Scores of economies have been effected in the modern plants and new methods have been introduced. The number of competent engineers engaged in designing new and improved apparatus is limited, but these men are constantly striving for simplicity and efficiency in sugar production. Their work, in effect, is to keep down the cost of this highly concentrated food for its hundreds of millions of consumers.

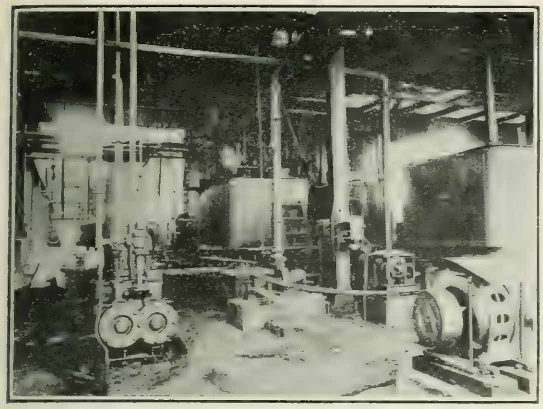
The use of compressed air in the raw sugar factories is of comparatively recent origin, and thus far it has not been employed to the extent to which it is susceptible.

The principal uses to which air is now directed in cane sugar factories, according to the engineers of the Honolulu Company, are the following:

a—To operate tools, tube expanders, tube cleaners, etc.

b—To agitate liquids under chemical treatment.

c—To elevate liquids and semi-liquids.



IN THIS VIEW A MOLASSES BLOW-UP TANK IS SHOWN IN THE CENTER BACKGROUND.

d—To accelerate the flow of heavy liquids when discharging from one closed vessel to another.

The operation of machine tools and cleaners is only required respectively, during erection, and when the factory is at a standstill, or during the week-end, or in the off-season, and the requirements are the same as in field construction work. Special mention might be made of air tube cleaners, however, which are particularly useful in a sugar factory for cleaning evaporator tubes.

The air drive is a very convenient one, and the ventilation and cooling of the cells is conducive to the comfort of the workman engaged.

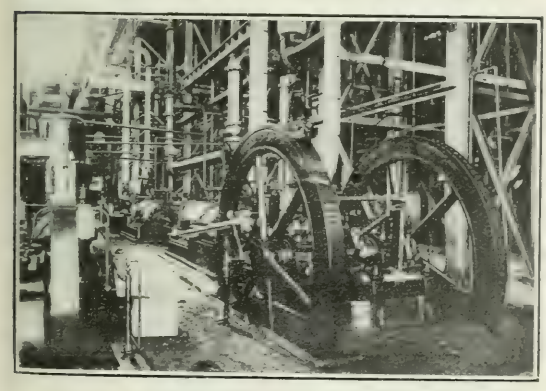
The agitation of liquids by compressed air is very widely used, and low pressures only are necessary to suit the depth of the liquid. The air is usually introduced to the open tanks by means of perforated coils.

The third field of service is a fairly old one, and was more in use when factories were built on the low plan. Modern factories are usually so arranged that the liquids gravitate where possible, particularly when referring to the thick *massecuites* which are now invariably arranged to flow from one vessel to another.

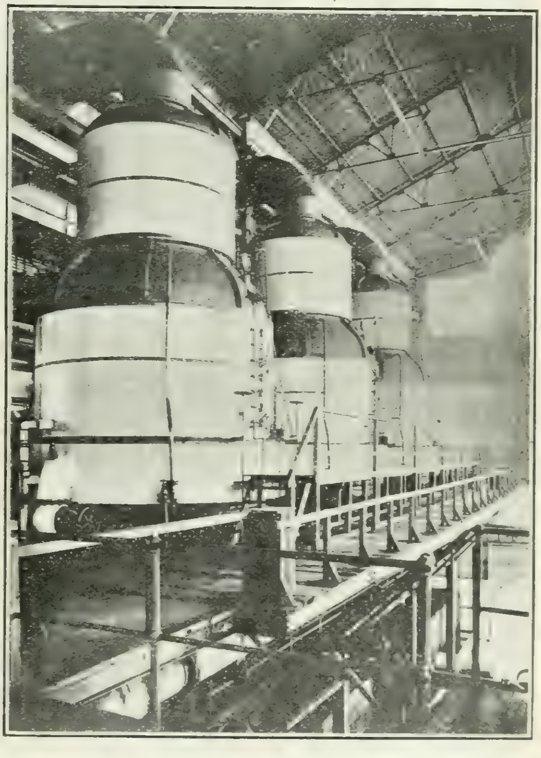
Particular instances may still necessitate the use of compressed air for elevating liquids, however, and the usual pressure necessary is from 30 to 50 lbs. per sq. in. The volume of air and its pressure will depend on the size of the vessels and other governing local conditions.

The fourth use mentioned above is a more recent innovation and growing in favor in large factories for assisting the flow of the thick *massecuites* from the vacuum pans to the crystallization tanks.

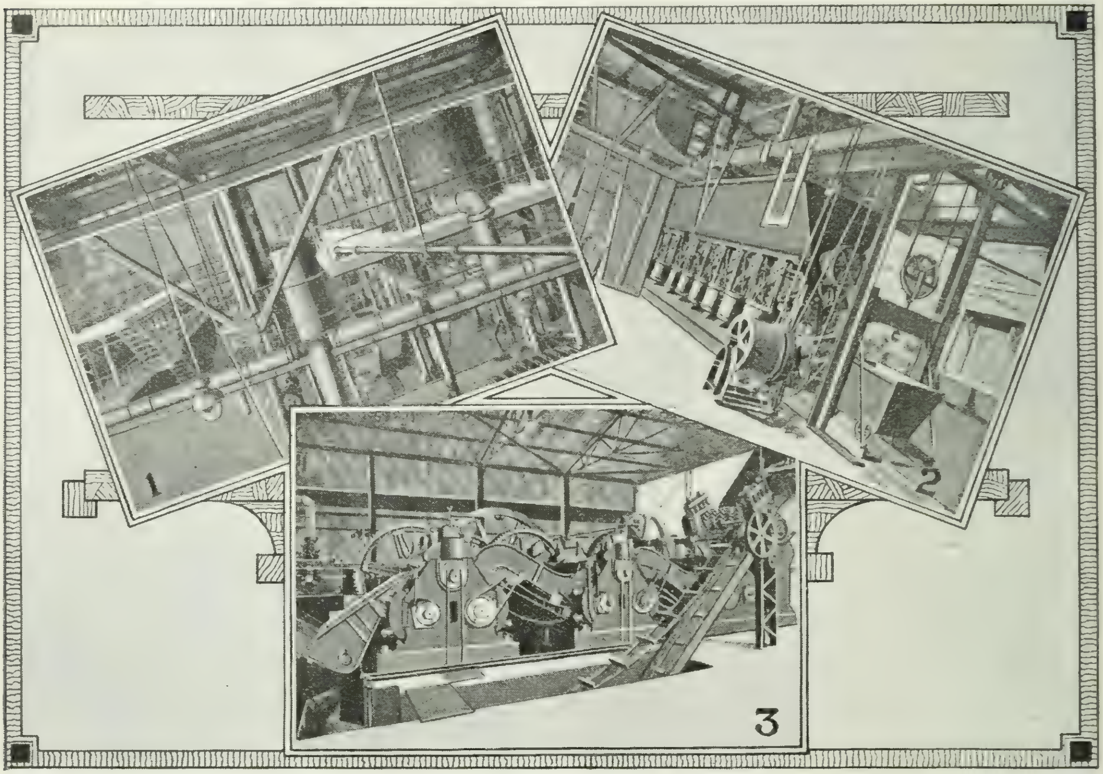
The *massecuite* when discharged from the pan consists of a thick magma of sugar crystals and molasses, and is commonly conveyed by means of open gutters. Closed pipes are now preferred, however, as this enables air pressure to be put into the pan to assist the flow of viscous liquids and reduces the time necessary to empty the apparatus. The usual pressure used is from 10 to



SINGLE, FLYWHEEL, VACUUM PUMP, DIMENSIONS 29½x39⅜"x39⅜" USED IN A SUGAR HOUSE.



THIS PHOTOGRAPH DEPICTS A HONOLULU IRON WORKS INSTALLATION OF THREE THIRTEEN-FOOT CALANDRIA PANS. THESE PANS ARE SOMETIMES ARRANGED SO THAT THEIR CONENTS MAY BE EMPTIED BY MEANS OF COMPRESSED AIR.

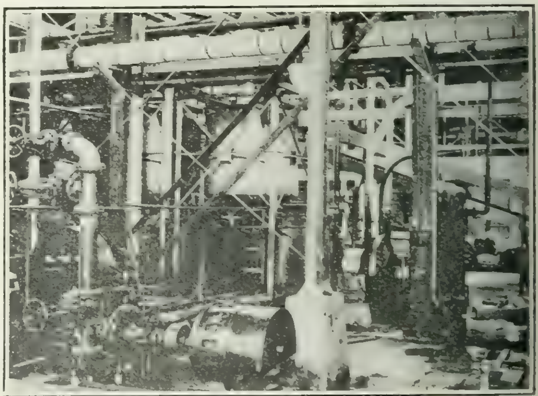


HERE ARE SHOWN THREE SPECIMEN VIEWS OF A COMPLETE SUGAR FACTORY INSTALLATION FOR CENTRAL VANNINA, CUBA, WHICH WAS DESIGNED, BUILT, ERECTED AND HANDED OVER IN OPERATION AND MAKING RAW CANE SUGAR BY THE KRAJEWSKI-PESANT CORPORATION, A COMPONENT COMPANY OF THE UNITED STATES AND CUBAN ALLIED WORKS ENGINEERING CORPORATION. FIG. 1 SHOWS THE SERIES OF VACUUM PANS AND EVAPORATION SECTION. FIG. 2 DEPICTS A BATTERY OF CENTRIFUGAL MACHINES IN WHICH THE MOLASSES IS SEPARATED FROM THE RAW SUGAR CRYSTALS. FIG. 3 SHOWS A FORMER TYPE OF KRAJEWSKI CRUSHER AND THE MILL ROLLS THROUGH WHICH THE CANE PASSES.

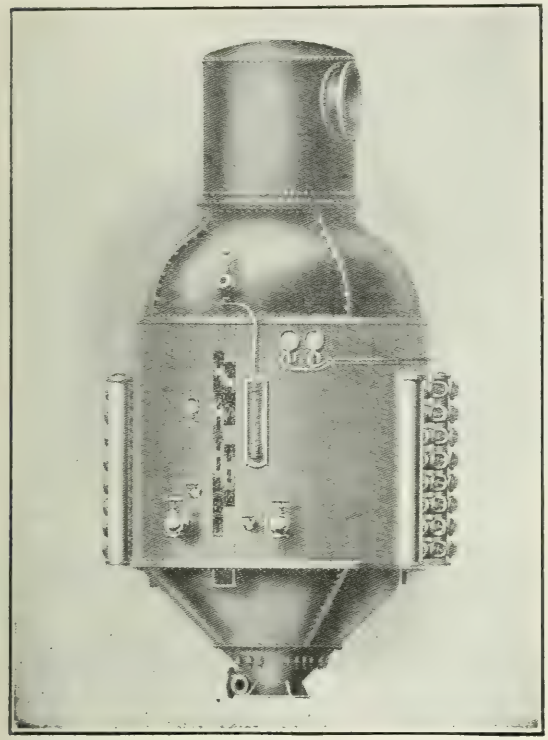
15 lb. per sq. in., whilst the volume should be based on the size of the vacuum pan and time required to empty. The *massecuite* is discharged through pipes varying usually from 8″ to 14″ bore and steaming-out connections are fitted at suitable points for cleaning out.

At the new Central Romana, La Romana, San Domingo, compressed air was used in the erection of the buildings and structural work, and the compressors operated at 75 lb. pressure. They are used for this and similar purposes during the off-season. At this modern plant there are two 10″x12″ duplex Ingersoll-Rand machines having 415 cu. ft. displacement per minute, at 210 r.p.m., driven by short belt drives from 75 h.p. motor running at 900 r.p.m. One of these is used as a spare. The short belt drive feature in a sugar factory is a consideration, because space is at a premium.

During the grinding season when emptying the vacuum pans, they operate at 10 to 15 lb. pressure and a suitable receiver is provided to give regulation. Usually a pressure of 8 lb. is found sufficient for this purpose and the results obtained from this arrangement have been good.



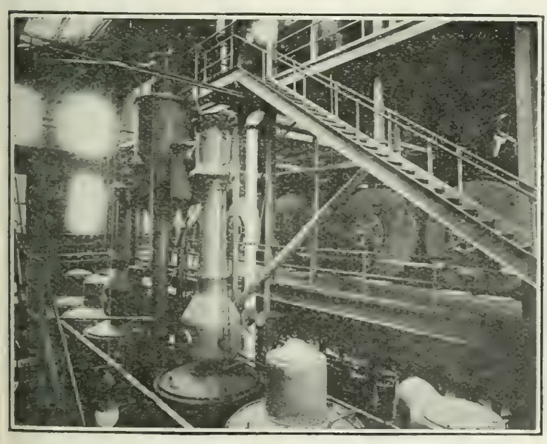
AIR COMPRESSOR AND RECEIVER INSTALLATION IN A CUBAN SUGAR MILL. THE RECEIVER IS AGAINST THE COLUMN ON THE RIGHT.



A MODERN VACUUM PAN MANUFACTURED BY THE UNITED STATES AND CUBAN ALLIED WORKS ENGINEERING CORPORATION OF NEW YORK AND HAVANA.

tremely satisfactory, making for neatness and cleanliness, besides saving considerable labor in the manipulation of troughs and increasing the operating time of the pans.

The illustrations will afford the reader an idea of the complicated and expensive machinery and apparatus that is required for the equipment of the modern cane factory. Plants for which the machinery installation costs several million dollars are by no means uncommon in these days of scientifically efficient production. Large concerns like the Krajewski-Pesant division of the United States and Cuban Allied Works Engineering Corporation, the Honolulu Iron Works Company and the Fulton Iron Works, in these days not infrequently make contracts for the building and erection of entire cane sugar plants, which are turned over in working order with a guaranteed production and housed in steel and concrete structures.



AN INSTALLATION OF CLOSED CRYSTALLIZERS. CONTENTS OF THESE ARE OFTEN EMPTIED BY MEANS OF COMPRESSED AIR.

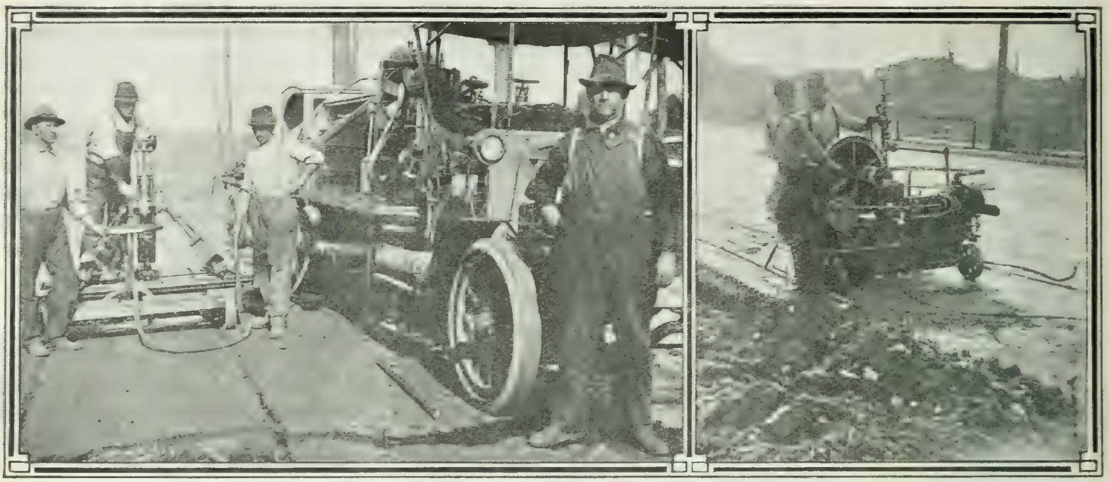
Good sugar production men are in demand and receive high salaries. Companies such as that owning Guanica Central in Puerto Rico provide for their principal employes and their families all of the comforts and conveniences it is possible to introduce into tropical or semi-tropical countries. Modern homes with wide spreading, shady porches, lawns and flowers, clubhouses, churches, moving pictures, outdoor sports and other diversions are provided. On the beautiful bay in which American troops first landed in Puerto Rico in the Spanish-American War, boating and good fishing are available, and the splendid stone boulevards of Puerto Rico, numbering some 1,200 miles of thoroughfares from which magnificent mountain and marine scenery may be viewed, are a paradise for the motorist.

Life in that particular sugar-growing country, at least, has its attractions and compensations.

Captain C. A. Duntley, who recently received his honorable discharge from the army after serving as captain in the 27th Field Artillery, has been elected vice-president of the Duntley-Dayton Company, with headquarters in the Westminster building, Chicago. He was born in Chicago on October 21, 1892, and received his education in the Armour Institute, Chicago, and Cornell University, from which latter school he graduated in 1914. Captain Duntley will have charge of the sales work of the pneumatic and electric tool department of the company, which consists of a complete line of portable electric drills and grinders, as well as a full line of accessories, such as hose and hose couplings, rivet sets and chisel blanks.

* * * *

Donald C. Barnes, Everett, Wash., manager of the traction and power properties of that city, has been appointed manager of the Seattle Division of the Puget Sound Traction, Light & Power Company, to succeed A. L. Kempster. He has moved from Everett to Seattle to make his headquarters in the Electric Building at Seventh avenue and Olive street.



Photos Compressed Air Magazine Illustration Service.

THE VIEW AT THE LEFT SHOWS A LOS ANGELES CITY DEPARTMENT MOTOR TRUCK THAT CARRIES AN AIR COMPRESSOR, TOGETHER WITH AIR DRILL USED FOR CUTTING THROUGH ASPHALT AND CONCRETE. IN THE PICTURE AT THE RIGHT IS TO BE SEEN A HOIST OPERATED BY COMPRESSED AIR AND USED FOR FILLING IN EXCAVATIONS.

City of Los Angeles Uses Compressed Air for Many Purposes

By CHARLES W. GEIGER.

THE LOS ANGELES water department has equipped two motor trucks with air compressors which are used extensively in maintenance work. The compressors are operated by the 40-h.p. motor that operates the truck, special transmission gear having been designed for this purpose. The radiator and fan from an old auto has been mounted on the compressor for keeping the same cool. The fan is operated by a belt running from the flywheel of the compressor.

The compressor has been equipped with a speedometer, taken from an old auto. The air tank is mounted on the rear of the truck. Compressed air is used for cutting and calking cast iron pipe and also for riveting and calking sheet steel pipe. It is also used for operating an air drill which has been designed by the superintendent of the water department for cutting through asphalt and concrete pavement, when excavations are to be made for laying new pipe or repairing old pipe. Compressed air is also used for operating a portable hoist in filling in excavations.

In cutting through asphalt and concrete, an old air drill that was used in the construction of the Los Angeles Aqueduct has been remodeled and mounted on a carriage which in turn is mounted on a truck. The truck can be easily and quickly taken apart and carried on the motor truck for transporting from place to place.

The truck which carries the air drill works along the side of the motor truck that carries the air compressor. An air hose connects the air drill with the air tank. The truck carrying the air drill is moved forward by means of a ratchet working on one wheel of the truck. The entire device straddles the strip of pavement that is to be cut through. A path four feet in width can be cut at one operation.

Three men are required to operate the drill and in moving the truck forward. A fourth man operates the compressor. One man operates the air drill, a second operating the ratchet moves the truck forward as the cutting progresses, and a third operating a wheel and ratchet, moves the air drill back and forth across the strip to be cut.

A sharp wedge is used in cutting through the asphalt. After a strip of asphalt has been cut through it is removed and loaded on to a motor truck. For breaking up the concrete a square bit somewhat heavy on the end is used. This bit is directed against the surface of the concrete while the air drill is operating, until the concrete is broken through for about an inch below the surface. The bit is then moved sideways about 6 inches and the pounding is directed at one point until this is broken through. This is continued until the entire width of the strip has been pounded, when the entire apparatus is moved forward about 8 inches, and the same operation is repeated. This pounding breaks up the concrete so that it can readily be shoveled from the trench into a motor truck. A space 4 feet in width and 120 feet in length can be broken up in one day.

The hoist used in filling in excavations is an old steam hoist that was used in the construction of the Los Angeles Aqueduct. This hoist travels along the excavation as seen in the accompanying photograph. The drum and cable drag a scraper which is used in filling in the excavations.

For operating the air hoist, a pipe connected to the air tank on the motor truck (which is parked along the trench) extends along the trench, with hose connections at convenient points. An air hose connects the hoist with this pipe. It requires three men to operate this equipment, two for the hoist, and a third man on the scraper. For moving the hoist forward, a rope attached to the truck that carries the hoist, extends forward to the truck carrying the air compressor. This rope passes through a pulley and is returned to the hoist. By wrapping this rope around the nigger-head and starting up the drum, the hoist is carried forward the required distance.

As shown in the photograph the trench was filled in by this means without interfering with street car traffic.

One of the motor trucks also carries a centrifugal pump, and compressed air is used in priming this pump. For this purpose a small air pump is mounted on the centrifugal pump and connected with the air tank. In order to start the suction, both the water pump and the small air pump are started up, then the main valve of the water pump is opened and the air pump closed.

VACUUM STREET CLEANER AT LOS ANGELES

Flushing of paved streets has been practically eliminated at Los Angeles, Cal., by the use of vacuum cleaners instead. The City Engineer, A. C. Hansen, gives the following particulars n his last annual report:

During the year ending June 30, 1918, four acuum cleaning machines were employed, working two shifts of 8 hours each under the upervision of two city inspectors. The city paid 0½ ct. per 1,000 sq. yd. cleaned, the contractor urnishing and maintaining the equipment with driver. The four machines clean approximately ,500,000 sq. yd. of pavement each day of two ifts. These machines have a vacuum suction pparatus, with a rotary fan operated by an ndependent motor mounted on a 2½-3½-ton ruck. Each machine is equipped with a speed ecordograf that registers the speed traveled during any portion of the day, the distance traveled, and the time during which no work is being done, whether standing in the garage or on the shift. As the speed at which these machines are operated is an important factor in the quality of work produced, the contract is conditioned for a speed not to exceed 4½ miles per hour, and as the recordografs register the miles traveled during each shift they operate (within certain limits) as a check upon the speed maintained while cleaning a street, and on the area claimed to have been swept.

MINING IN NEW YORK CITY

By LINWOOD H. GEYER

NEW YORK CITY is perhaps one of the biggest mining camps in the country when thought of in terms of rock drilling, blasting and rock removal. The work ranges from the sinking of shafts, driving of tunnels, cut and cover subways and foundation sinking to cliff removal and road work. A notable illustration is the elimination of the present grade crossing at 161st Street and the Concourse, now being done by the Fred Schneider Company, Inc. To prevent de-

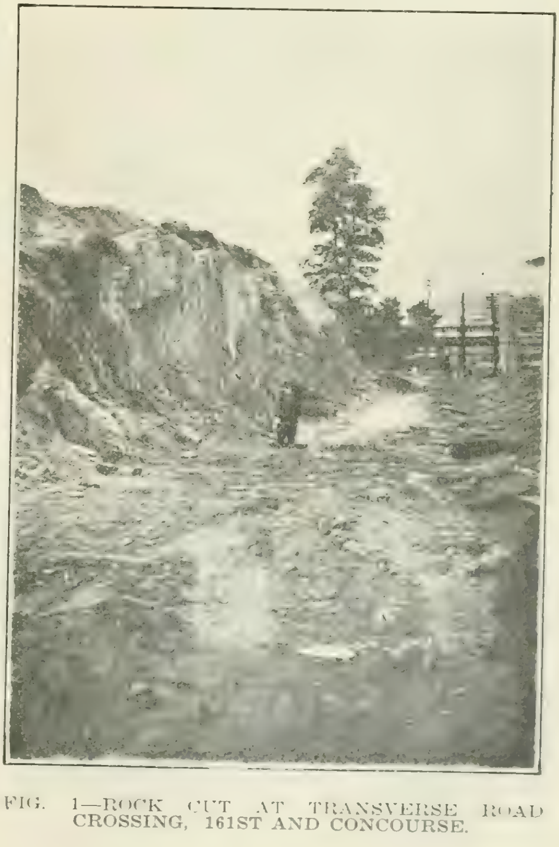


FIG. 1—ROCK CUT AT TRANSVERSE ROAD CROSSING, 161ST AND CONCOURSE.

lays of the rapidly increasing traffic on the Concourse and avoid danger, the crosstown street is being lowered. This project, involving the removal of a large yardage of hard rock, and the drilling of New York altered gneiss offers another example of the possibilities of the hand hammer drill. The desired result and the method of highway and bridge construction are similar to the completed work at the Kingsbridge Road transverse crossing.

The average cut is 20 feet with a maximum of 35 feet. (Fig. 1). Up until the present time down hole drilling has constituted the greater portion of the work. However, due to the results of blasting, it has been found necessary to drill a number of lift holes in front of the steam shovel.

At first, tripod piston air drills were employed, on the assumption that they were necessary to deep-hole drilling. An average footage of 70 feet per 8 hour day was realized. The contractor, however, selected three Ingersoll-Rand type DDR-13 Jackhamer Sinkers, and, after a test, discarded the piston drills. Since their installation the Jackhamer Sinkers have been drilling to an average depth of 20 feet. The maximum total per drill per 8 hour day has been 151 feet while the average footage is 120 feet. The air is furnished by a portable compressor and the pressure at the drill is 75-80 pounds per square inch.

One inch hollow hexagon steels with 4-point cross bits are used. The starting bit has a diameter of 2⅝" and the gauge varies ⅛" with every two foot change. This means that the contractor is bottoming 1½" holes at a depth of 20 feet. All steels are hand sharpened.

The change in drilling equipment has afforded the contractor a saving in both time and money which will pay for the installation many times over. Two men were formerly required for each piston drill and considerable time was lost in moving the drill and in changing steels. Not only does the Jackhamer Sinker drill nearly twice as much but it requires but one man to operate and move the Jackhamer Sinker. The elimination of dead moving time by not having to shift the heavy tripod mountings in itself constitutes a considerable saving. The Jackhamer Sinker is readily portable and has no chuck or saddle bolts.

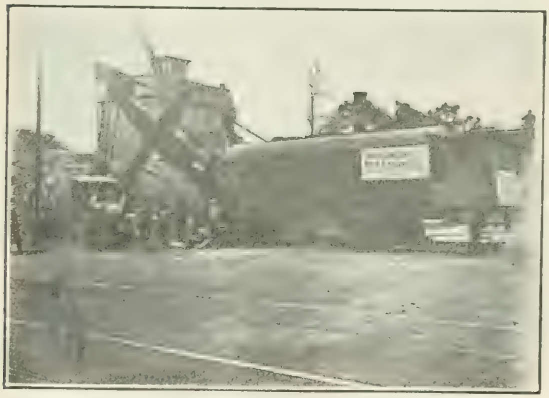


FIG. 2—EIGHTY-FIVE TON RAILROAD SHOVEL REMOVING ROCK AT 161ST ST. AND CONCOURSE.

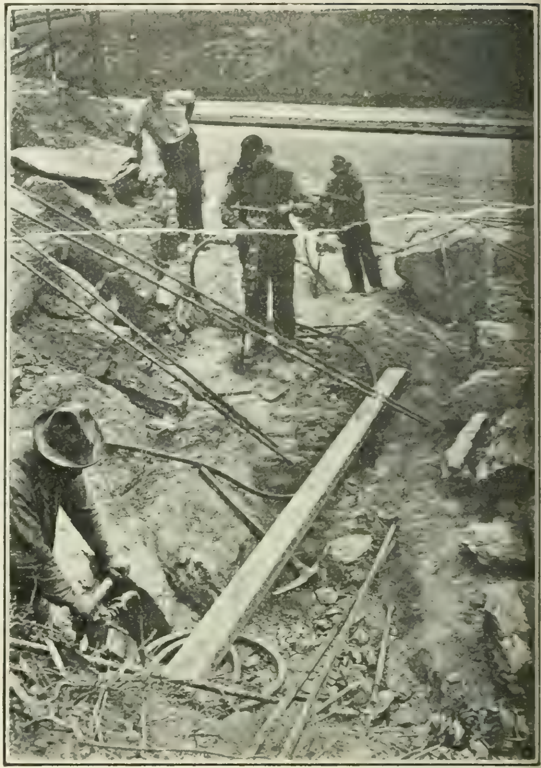


FIG. 3—D D R-13 INGERSOLL-RAND JACKHAMER SINKERS AT WORK AT 161ST ST. AND CONCOURSE.

This saving can best be realized in the comparison of the old with the new steam shovel equipment. With the piston drills a 25-ton shovel was ample, but since Jackhamer Sinkers have been used the contractor has found it necessary to install an 85-ton railroad shovel (Fig. 2) to keep up with the removal of the rock.

Horacio V. Garza has been appointed assistant purchasing agent of the National Railway of Mexico, with headquarters at New York City succeeding F. P. de Hoyos, local purchasing agent.

A Peculiar Pneumatic Cassion Problem

THE WESTPORT station, near Baltimore, of the Consolidated Gas, Electric Light and Power Company is located about 200 ft. from the Patapsco River and the space between the power house and the river is used for the storage of coal brought up the river in barges and unloaded by a tower hoist. It was determined last year to add a second hoisting tower and a bridge. It was to be expected that in the building of the foundations for this tower there would be special difficulties encountered, because the weight of the coal stored between the power house and the water front had started a movement of the ground toward the river sufficient to throw the discharge tunnels badly out of line. The Foundation Company of New York was engaged to design and construct the necessary piers, and for the description of operations, here presented in condensed form, and for the accompanying illustrations we are indebted to *Engineering News Record*.

Borings had shown that, under about 50 ft. of soft material, there was a stratum of compact sand. It was evidently necessary to sink the foundation piers far enough into this hard stratum to permit them to withstand the flow of the soft material above.

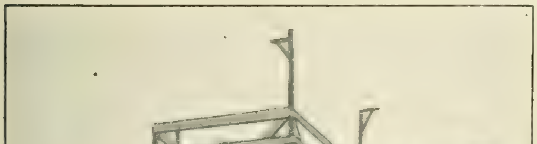


FIG. 1—CAISSONS SUNK THROUGH SHIFTING GROUND.

The design finally adopted consisted of four cylindrical piers, 10 ft. in diameter, centered at the corners of a 24x25-ft. rectangle. These piers were built with concrete walls, 18 in. thick, re-inforced as indicated in one of the photographs, and were sunk by their own weight until they reached solid ground. Air was then applied, and the rest of the sinking was done by the usual pneumatic method. The piers were carried down about 20 ft. to hard bottom, making the total depth 68 ft. below water level.

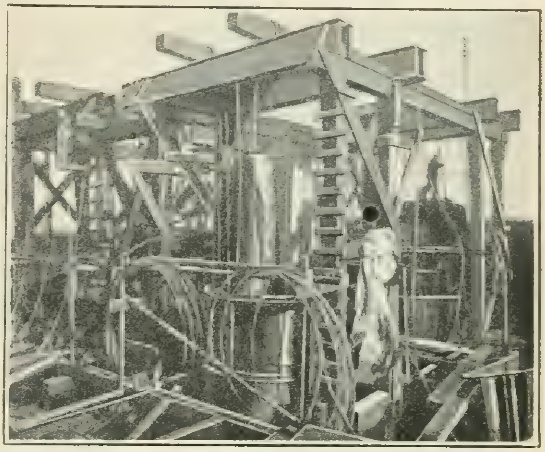


FIG. 2—FOUR PAIRS OF WIRE CABLES SUPPORT EACH CAISSON.

THE CONTRACTOR'S PROBLEM

During the first stages of the operation the contractor was faced by the problem not only of keeping the caissons from sinking too rapidly, but also of holding them in alignment until they were solidly grounded. Four lines of piles were driven at right angles to the river; that is, parallel to the direction of movement of the ground. These piles were capped with 12x12-in. timbers and pairs of 24-in. 80-lb. I-beams laid across from one line to the next over each of the four caissons.

Each caisson was suspended from these I-beams by four pairs of wire cables attached to the cutting edge and extending up through the walls as they were concreted. Each cable passed up between the pair of I-beams, made a half turn over an oak block, and was fastened to itself with three ordinary clips. One cable in each pair actually supported the load while the companion cable was held in reserve for safety.

PURPOSELY OUT OF PLUMB

In order that the cutting edge might be in correct position when it reached solid bottom, it was necessary to counteract the movement of the soil, by sinking the caisson out of plumb. The caisson was kept at this angle by adjustment of the supporting cables. When it was necessary to throw the caissons further out of plumb, the cables on the river side were slacked off, throwing most of the load to the cables on the powerhouse side and causing the caisson to tilt accordingly.

It was the contractor's original intention to have each cable pass through pairs of blocks, so that it could be more easily adjusted, but as these blocks were delayed in transit, the lowering was done merely by loosening the clamps and allowing the cable to slip by itself. The safety cable in each pair was slacked off first the proper amount, and the clamps were tightened so that the motion of the caisson would be stopped at the proper point when the supporting cables were loosened.

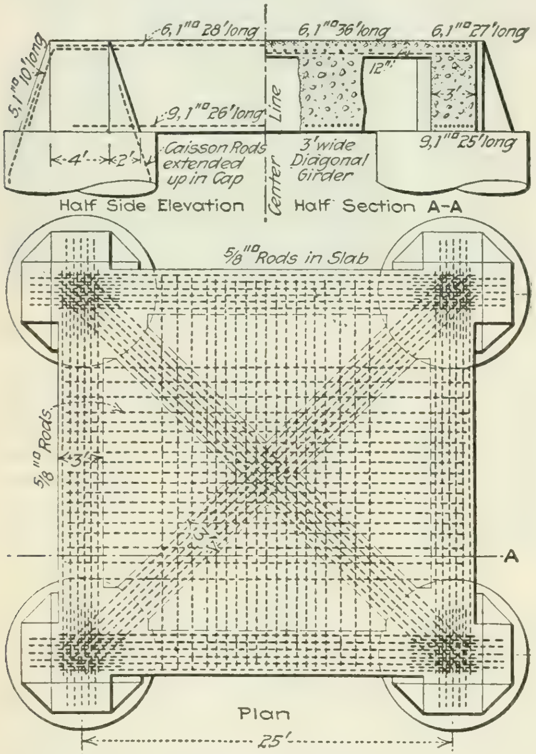


FIG. 3—REINFORCED CONCRETE CAP FOR PIERS.

After the caisson had been sunk 20 or 30 ft. it was necessary to shore against the side of the power house to hold it in the proper inclined position. When the cutting edge had been grounded securely, however, these shores were removed and the caisson was allowed to right itself.

After all four piers have been completed, they will be tied together at the top by deep concrete girders, which will stiffen them against the movement of the ground. Details of this cap and its reinforcement are shown in the diagram. The caissons are to be filled with a concrete core about 12 ft. thick at the bottom, with sand filling above it.

A. S. Loizeaux, electrical engineer, is in charge of construction for the Consolidated Gas, Electric Light & Power Co., and E. D. Edmonston is general superintendent of the Westport plant. The job was handled by C. B. Kowenhoven, superintendent, and William J. O'Neill, general foreman, under the direction of W. B. Taylor, district manager of the Foundation Company.

VACUUM OVENS FOR DRYING CORES*

IN THE USE of ovens for core drying the results desired are, the removal of the moisture and the oxidation of the bond. To attain the first the second is often more or less defeated. A great many core ovens are heated to a temperature which is destructive to the binding material. This makes a weaker core or necessitates the use of more bonding material. In the ordinary core oven, operated at atmospheric pressure, great oven capacity is needed on account of the slowness of the drying.

It occurred to me that the ideal method of drying the cores would be by diminished pressure at a low temperature. Reducing the pressure below atmospheric pressure, lowers the boiling point of the moisture in the cores and makes it possible to dry them at a low temperature, which would give the maximum effect of the bonding materials.

VACUUM OVEN CONSTRUCTED

To test this out I made a small vacuum oven as follows: A 3-inch pipe, 1 foot long, was fitted with a permanent cap at one end and a removable cap at the other end. The removable cap was fitted with two stopcocks and two hobs for a thermometer and a mercury vacuum tube. One of the stop cocks was connected to an exhaust pump and the other to a hot air oven, heated to 250 degrees Fahr. The cylinder was immersed in a tank of linseed oil heated to 250 degrees Fahr.

Two cores were baked at a time in this oven by placing them on a rack in the pipe and screwing on the top cap. The stopcock connected to the air oven was closed and the one to the exhaust pump was opened. When the air in the oven was exhausted to the limit of the pump (18 inches of mercury), the valve to the hot air oven was opened until atmospheric pressure was

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*Abstract from G. W. Merrefield in *Foundry*.

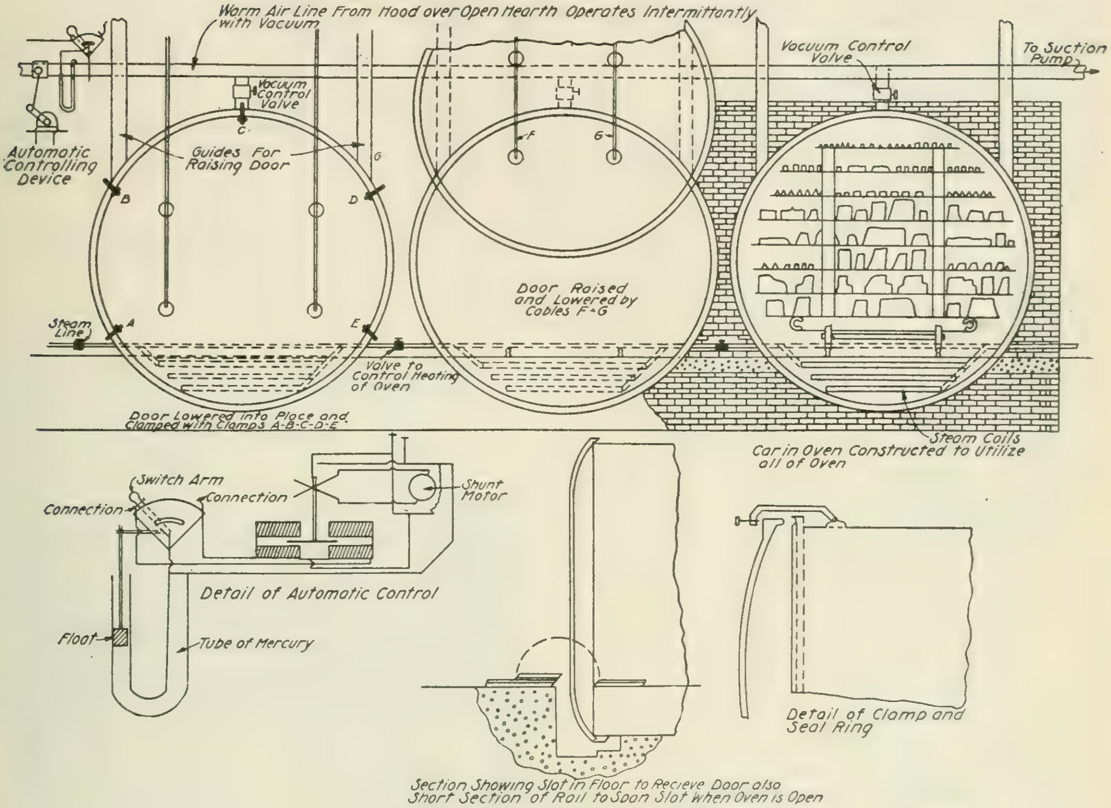

Warm Air Line From Hood over Open Hearth Operates Intermittantly with Vacuum
Vacuum Control Valve
To Suction Pump
Vacuum Control Valve
C
Automatic Controlling Device
Guides For Raising Door
G
B
D
F
G
Steam Line
A
E
Valve to Control Heating of Oven
Door Raised and Lowered by Cables F+G
Door Lowered into Place and Clamped with Clamps A-B-C-D-E
Steam Coils
Car in Oven Constructed to Utilize all of Oven
Switch Arm
Connection
Connection
Shunt Motor
Detail of Automatic Control
Float
Tube of Mercury
Detail of Clamp and Seal Ring
Section Showing Slot in Floor to Recieve Door also Short Section of Rail to Soan Slot when Oven is Open

FIG. 1—PROPOSED ARRANGEMENTS OF THREE VACUUM CORE OVENS.

restored in the cylinder, and then again closed. This procedure was repeated until the cores were dried.

TIME SAVED IN THE DRYING

Comparative drying tests on small cores of the same size, made from the same batch of sand, showed that the vacuum drying at 250 degrees Fahr., with 18 inches of vacuum, was complete in from 15 to 25 minutes, while cores dried in a gas oven at 350 degrees Fahr. took 45 minutes to completely dry them. This was ascertained by weighing the cores until a constant weight was reached. The only difference in the drying is that the gas-oven-dried cores had the bond more completely oxidized than the vacuum-dried cores. But as this oxidization need not necessarily take place in the oven, the time saved in vacuum drying is apparent.

PROPOSED VACUUM OVENS

Fig. 1 is a sketch of a proposed battery of three vacuum drying core ovens. They are supposed to be made of boiler steel, air-tight and of sufficient size for the purpose. The cylindrical form will withstand the atmospheric pressure without buckling, when under a high vacuum. They are to be heated by live steam which will be able to impart a temperature of 250 to 275 degrees Fahr. in the ovens. Each oven is to be connected to the main exhaust line at the back and top and can be shut-off from connection with the system, when being loaded or unloaded, by turning the connecting valves.

An exhaust pump will be connected to one end of the exhaust line and on the other end will be a rotary valve operated by a shunt motor, which will automatically open the valve when the mercury in the tube reaches a predetermined height of vacuum, by closing the circuit, operating by either the lever or floating tube control shown in Fig. 2. As soon as this valve opens, it will allow dry warm air (supplied from metal melting furnace) to be drawn into the ovens, to replace the moisture laden air drawn out by the vacuum. When the vacuum is released by the inrush of warm air, the mercury drops in the tube to atmospheric level and closes the reverse circuit by the other contact, reversing the motor which again closes the warm air valve. While this operation is taking place, the exhaust pump is continually pumping, so that as soon as the valve is again closed the new air in the ovens is exhausted until the mercury reaches the point at which it again closes the circuit.

This operation is repeated periodically and automatically during the time of drying, causing the boiling point of the water to be lowered to approximately 115 degrees Fahr., if the maximum vacuum is brought to 26 inches of mercury. This is readily obtained in commercial drying of food, etc., by vacuum. The vapors are actually drawn out of the cores, regardless of their size, in the effort to restore equilibrium while the vacuum is increasing. When the valve is opened and warm, dry air is allowed to rush in, the vacuum spaces within the cores are filled with this air, and again is drawn out laden with the moisture vapors when the next vacuum period occurs.

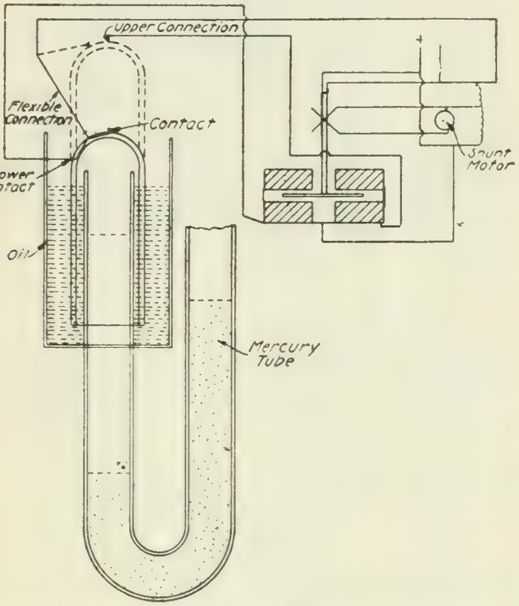


FIG. 2—DETAIL OF AUTOMATIC CONTROL.

One can see that the complete removal of the moisture would soon take place under these alternate conditions and would take place regardless of the size of the cores or whether they were closely-packed in the oven. In fact, the closer the oven was filled the less time it would take per unit of cores, as there would be less air space to be pumped out each turn of the vacuum.

The doors could be made of cast or pressed steel and hung on cables as shown. An air-tight joint could be made by a composition or asbestos packing ring in the outer run of the casing and the door clamped tight with the clamps illustrated. This could be quickly done after each loading. The doors would be swung up out of the way on the cables during the loading and unloading operation.

The ovens could be placed inside the present core ovens, using the latter as insulators to prevent loss of heat, cutting out the bottoms to bring the steam heating coils below the floor level and to allow the perforated bottom and tracks to coincide with the general floor level.

THE ROBINSON AUTOMATIC TRAIN PIPE CONNECTOR

THE PROBLEM of automatically connecting and disconnecting the air brake pipes when railroad cars are coupled or uncoupled would at first thought seem to be a very difficult and complicated one, but the practical solution of it as here shown is really astonishingly simple. The task is not really any more difficult for first class passenger service where not only the air brake pipe but also the conductor's air signal and the steam pipe are also to be similarly connected.

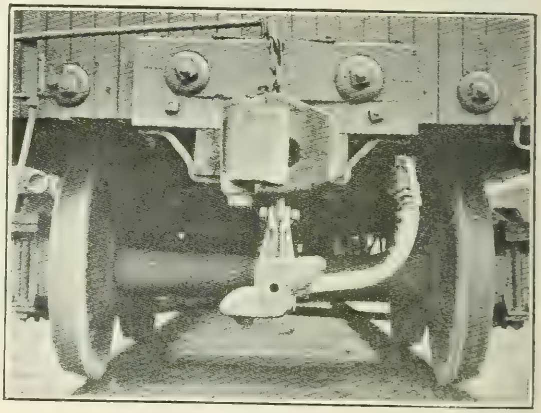
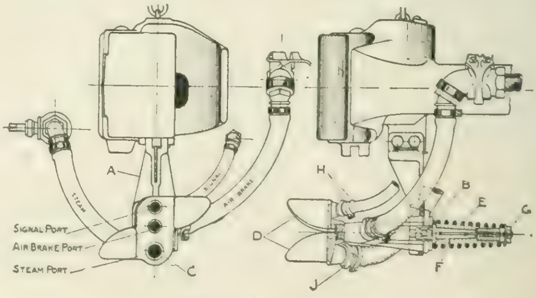


FIG. 1.

Fig. 1 shows the automatic connector as installed upon an ordinary freight car equipped with standard train coupling. Below the train coupling and centrally located is seen the vertical flat face of the automatic air coupling with the



FIGS. 2 AND 3.

hole in the center for the air and two flaring projecting wings upon opposite corners. The connector is so suspended as to be free to move a sufficient distance both vertically and laterally to compensate for differences of precise location on different cars and for variations caused by differences in loading, curves, etc. The projections on the faces when they come together and mutually lap over the corners of each other bring the two faces to correspond and locate the air holes opposite each other.

The connector also is movable lengthwise of the car and each face to be coupled is pressed forward by a stiff helical spring, so that when two cars come together to be coupled the faces of the connectors are the first surfaces to come in contact and they are thrust back a certain distance, each opposing the other, and they are held pressed together constantly with sufficient force to make the pipe joints tight, suitable gaskets surrounding each opening.

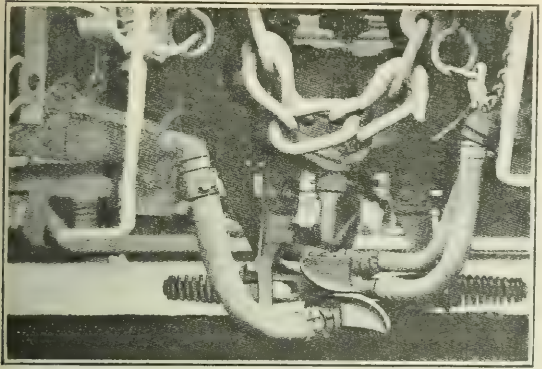


FIG. 4.

Figs. 2 and 3 give front and side views respectively of the coupling as installed for passenger service. The short sections of hose of course remain permanently coupled, and are not subject to wear or abuse. Fig. 4 shows the ends of two cars with all appurtenances as actually connected in service. The connector has been thoroughly tested in service and has the approval of the Interstate Commerce Commission. The address of the Robinson Connector Company is 17 Battery Place, New York City.

USES OF MERCURY*

The use of mercury for thermometers consumes, according to F. L. Ransmore, only a small fraction of the total quantity produced. Mercury is a constituent of many drugs and chemicals, including calomel and corrosive sublimate and mercuric oxide and mercury salts are used in the manufacture of certain chemicals of which the mercury itself does not form a part. For example, in one process of producing glacial acetic acid, acetylene is oxidized with mercuric oxide, the same lot of mercury being used repeatedly. Mercury is used also in making phthalic anhydride and phthalic acid, organic compounds which are employed in the dye industry but which themselves contain no mercury.

The use of mercury fulminate as a detonator has expanded enormously with the increase in the variety and efficiency of the high explosives now manufactured for industrial and military purposes, and, although primers have been made of other materials, especially for small arms, no substitute has found general acceptance.

Quicksilver is now used extensively in the manufacture of anti-fouling ship-bottom paint. The consumption of quicksilver in gold-dredging and other placer operations is still large. In gold-quartz mills, however, the amalgamation process has been partly supplanted by cyanidation.

Among the varied uses to which quicksilver is put may be mentioned also its employment in dental amalgams; in the manufacture of laboratory air pumps and other scientific instruments; in thermostats, gas governors, and similar appliances; in mercury-vapor electric lamps; in compounds for preventing scale in steam boilers; in cosmetics; in certain electrolytic processes for the manufacture of chlorine, caustic soda, and picric acid; in primary batteries, electrolyzers, rectifiers, and other electrical equipment; and in felt making.

From Bulletin 666-FF. U. S. Geological Survey

THE CEMENT GUN ON THE RAND

The Cement-Gun is at present in use at the Modder East, Ltd., for making brattices underground. These brattices were formerly made of bricks, but we understand from the mining people that the "Gunite" brattice is a much more satisfactory job in every way, and does not cost 50 per cent. of the brick brattice. We are informed that Springs Mines have ordered two Cement-Guns for similar work. The machine is extensively used for making panels for walls and roofs in buildings, and also for the protection of iron and steel from corrosion.

Clement K. Quinn and associates, of Duluth have purchased from the Jones & Laughlin in s the Rolling Mill mine, at Negaunee The Rolling Mill shipped 250,000 ton 1916 and has a capacity of 300,000 tons dle during 1917 and 1918.

Survey of the Technical Field

Edited by FRANK RICHARDS

EXPLODED GAS CYLINDERS INVESTIGATED

An elaborate report of a very complete investigation into the causes of fracture of two compressed gas cylinders—one for hydrogen and the other for oxygen—which burst while being filled, is given in *Zeitschrift des Vereines deutscher Ingenieure,* March, 1919.

The hydrogen cylinder was being filled with the gas at a pressure of 140 atmos. The explosion was extremely violent; the floor on which the cylinder was standing was found to have a hole in it 75 cm. deep; the flask or cylinder flew upward like a projectile, passed through the roof of the filling room, and fell in a garden some 85 m. distant.

An examination of the plant (compressor and fittings) revealed it to be in order. The gas was produced electrolytically and collected in a gasholder, after which it passed into a two-stage compressor and was compressed to a filling pressure of 150 atmos.

A full chemical, mechanical and micrographic examination was made of the fractured cylinder, from which the writer concludes that it satisfied the requirements of the authorities. Probably a "fold" or crease formed in the steel while being mechanically treated, and this creasing gave rise to a crack or cracks, which were most likely the cause of the explosion. He suggests that in addition to the prescribed precautions relating to the inspection of these vessels, each seamless vessel should be "flash-tested" (this test is not defined) before the head is put on, in order to find faulty places. This method has been adopted by the military authorities prior to the acceptance of all shells. This test would enable any creases to be discovered in the steel.

In the case of the oxygen cylinder a greater number of splinters were available. The cylinder is said to have burst during the process of filling at a pressure of 80 to 100 atmos. The oxygen used was obtained from liquid air. The cylinder was of similar construction to the hydrogen cylinder, being of the seamless-steel type. The same official regulations applied in this case also. The article describes in detail the mechanical, chemical, etc., tests carried out on the fragments collected.

Numerous causes contributed to the bursting of the cylinder as shown by the experimental results. The steel was weakened at one particular part where the test initials were stamped, as the stamp penetrated to half the wall thickness of the cylinder. The steel was too brittle for the purpose in question. It was very sensitive to dynamic stresses. The author suggests that the regulation regarding the stamping of these cylinders should be modified. The stamping should be reduced to a minimum, and be done when the steel is in a red-hot state. A mere pressure test is, when employed alone, very defective. It is much more important to test the inside and outside surfaces and the thickness of wall of each cylinder prior to putting on the top.

SANDBLASTING AUTO BODIES

The photograph depicts the sandblasting of the metal body of a sedan with a stream of sand, driven through the hose under air pressure, to cut away grease and dirt that has collected on the metal surface prior to the application of the priming coat of paint. This assures a perfect foundation for the elaborate finish that follows. The workman is masked for obvious reasons.

Photo copyright, Keystone Photo News Co., N. Y.

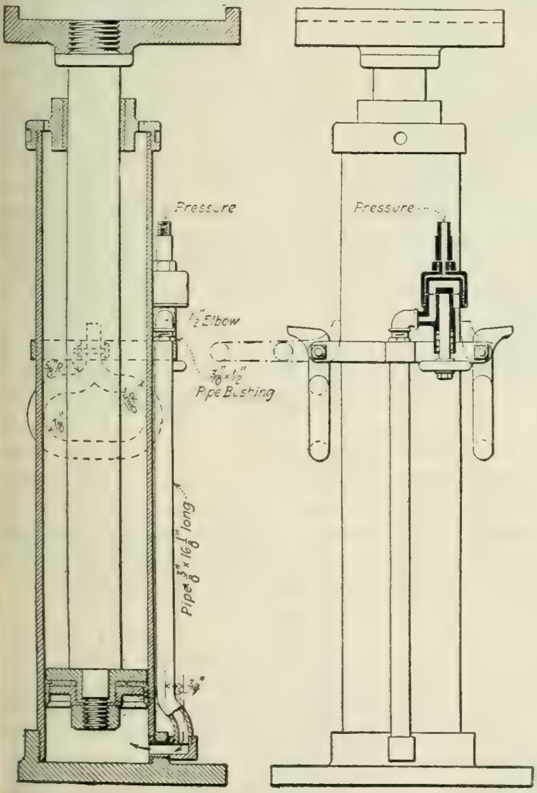
TEST AIR LINES WHILE SHOP IS FLOODED BY CLOUDBURST

P. H. Trout, of Roanoke, Va., author of an article on determination of air leakage, which appeared in the July issue of COMPRESSED AIR MAGAZINE, writes to us under date of July 31 that there was a rather interesting sequel to the publication of his test formula. The plant with which he is connected was flooded by a cloudburst, and for 48 hours all the shop area was covered by water.

"We turned the air on the mains," he writes, "and easily located all leaks in the ground lines by the bubbles. We found that most of the leaks were at the various hose connections and through leaky valves. We also found quite a number of valves were partly open. We found only two or three leaks in the underground pipes, but one of these in a 'dead' line was very bad. It is gratifying to know that we have no underground leaks and can easily stop the greatest loss of air."

INTERESTING PNEUMATIC JACK FOR LOCOMOTIVE WORK

Mr. J. Long in *The American Machinist,* presents detailed, dimensional, working drawings of the interesting pneumatic jack here shown in elevation and vertical section, which has been found to render valuable service in locomotive repairs. Its principal use is for putting in place the heavy pedestal caps which, owing to their weight and the difficulty of getting them into the position they occupy, ordinarily require the services of two or three men to place them. The swinging handles at the sides of the jack will be noticed. These jacks are used in the pit, and to place a pedestal cap it is only necessary to put the cap on the top shoe of the jack, turn on the air and guide the cap to place. The cylinders are made of 4 in. extra-heavy wrought iron pipe, bored. The piston is of axle steel, and is fitted with a cup leather washer.



ELEVATION AND VERTICAL SECTION DRAWINGS OF JACK FOR LOCOMOTIVE WORK.

RAPID AIRPLANE DEVELOPMENT

The following statement of the National Advisory Committee for Aeronautics shows the development in airplanes which has been made since 1903. The first man-carrying airplane flights were made in December, 1903, with the Wright Bros. engine, developing 12 hp. and weighing 152 lb., or 12.7 lb. per hp. In 1910, the average horsepower for aeronautic engines had increased to 54, and the weight had decreased to 5.7 lb. per hp. After another 7 years, in 1917, the average power output had advanced to 243 hp., and the weight had decreased to 2.8 lb. per hp.

In March, 1918, the Liberty motor developed 432 hp. for a weight of 808 lb., or 1.86 lb, per hp. At present, the Liberty motor is developing a maximum of 450 hp. for a weight of 825 lb., or 1.83 lb. per hp.

The average consumption of fuel decreased from about 0.8 lb. per hp. in 1903 to 0.55 lb. in 1918, and for the Liberty engine to 0.50 lb. The present consumption is about 0.46 lb. per hr.

For one horse power of energy expended $500 worth of textiles is produced, $300 worth of iron or steel, $1700 worth of printing. In the textile industries, where the cost is not exceptional, the cost per horse power is calculated to $20 or $30, indicating a power cost of 5 per cent. of the total cost of production. Development of a river of electrical energy is suggested, stretching from New England to the Southern States, and the transformation of coal to power in the mining fields, instead of transporting it over the railroads to factories far and near.

A total of 81,741 disabled soldiers and sailors have registered for vocational training with the Federal Board for Vocational Education, Washington, and 2079 have started their training. Of the 4376 cases approved for teaching by the board, 1200 have been approved for trade and industrial training, 846 for agricultural, 850 for professional courses, and 392 are taking academic courses. Those taking up some branch of mechanics involving operation, repair and up-keep of gas engines number 291.

HOW SOME OLD AIR RECEIVERS WERE CONVERTED INTO COAL STOVES.

SCRAPPED AIR RECEIVERS FOR COAL STOVES

The half-tone tells practically all there is of the story. Mr. Thomas P. O'Connor, Master boilerworker at the Navy Yard, Philadelphia, received an order that he promptly provide thirty coal-burning stoves of a type and size suitable for the care and preservation of boilers and machinery of vessels to be put out of commission. Inquiries were made of several establishments, and the best offer was $41 for each stove with delivery thirty days from order.

One of the boilermakers found in the scrapyard twenty-four seamless air tanks which had been discarded. It was found that they were of the right size for the purpose and they were at once converted into coal burning stoves as seen in the illustration.

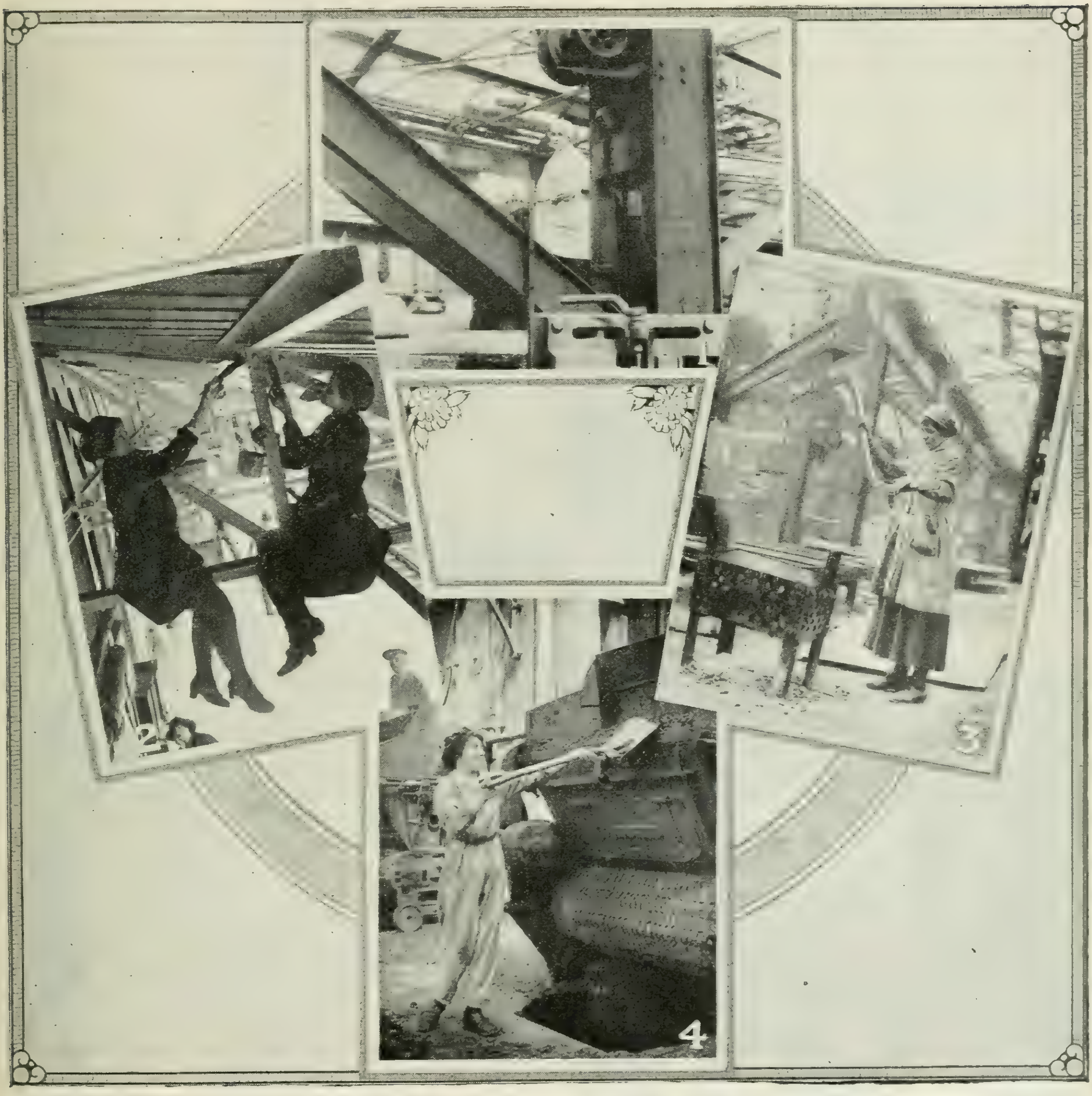
Two of the receivers unconverted are seen at the left of the picture.

The total cost for changing each one was slightly less than $7, thus making a total saving to the government of $816.

C. Raymond Messinger, vice-president and general manager Chain Belt Co., and Sivyer Steel Casting Co., Milwaukee, Wis., who returned home lately from a three months' tour of Great Britain and the continent, says the financial situation and import restrictions imposed by European nations does not present an immediately encouraging condition to American manufacturers, although he looks to see an exporting movement possible this autumn.

Director-General John Barrett of the Pan-American Union is authority for the statement that as a result of war conditions the United States is buying and selling more with Latin America than all the other countries of the world put together. This condition, of course, will not last unless the commercial and financial interests of the United States are alert and are ready for the competition which is surely ahead of them. It is necessary in this connection to understand the facts about the relationship of the United States to German trade. The figures in 1913-1914, the last fiscal year before the war show that the total value of the commerce of the United States with Latin America was $800,000,000, that of Great Britain $650,000,000, and that of Germany $500,000,000, or $300,000,000 less than that of the United States. Fifteen years ago Germany led the United States in trade with fifteen or twenty Latin American countries. At the outbreak of the war the United States led Germany in fifteen of the twenty countries. At the conclusion of the war the United States has a greater trade with Latin America than all the rest of the world and Germany has practically nothing.

The three new Bureau of Mines rescue cars, construction of which was long delayed on account of war conditions, have now been completed. These cars are being stationed at Terre Haute, Ind.; Ironwood, Mich.; and Rock Springs, Wyo. The cars are of a new model and are well equipped in every way.



(Official British photographs from Feature Photo Service-Crown copyright reserved.)

Women in British Industries

1—GIRL WORKING A HUGE CRANE IN THE WORKSHOP OF AN ENGLISH SHIP-BUILDING YARD.
2—PAINTING ROOF GIRDERS ABOVE RAILS IN A RAILWAY RECEIVING STATION OF AN INDUSTRIAL PLANT.
4—WOMAN FEEDING AN AUTOMATIC STOKER OF A FACTORY POWER PLANT.
3—CRANE GIRL IN A SCOTTISH PLANT.

In the course of the war and since the war, women have played a large part in the industries of Great Britain. As in the United States, it is likely that a large number of women in England and Scotland will continue in their emergency occupations and the subject is one that is taking the attention of those solving labor problems. Thousands of women workers on both sides of the water have registered vigorous protests against giving up the foothold they have obtained in the industrial fields, where a considerable percentage have performed manual labor that was formerly considered only in the province of men. There have been sharp debates whether women do their work as acceptably as men, "equal pay for equal work" being a resultant issue.

ENGLISH AERIAL LIMOUSINES

Airplanes especially built for commercial use are now being employed by the enterprising British. The capacity of the particular machine shown in Fig. 1, is one ton, and it will accomodate in comfort, even luxury, four passengers. It is all enclosed and fitted up somewhat as a limousine, with glass windows and with shades. You may smoke in its commodious interior and also enjoy all the conveniences of a closed automobile. Fig. 1 shows a passenger entering the saloon of a "Bat" airplane, the first machine to be constructed for strictly commercial purposes and to be made ready for the air in England.

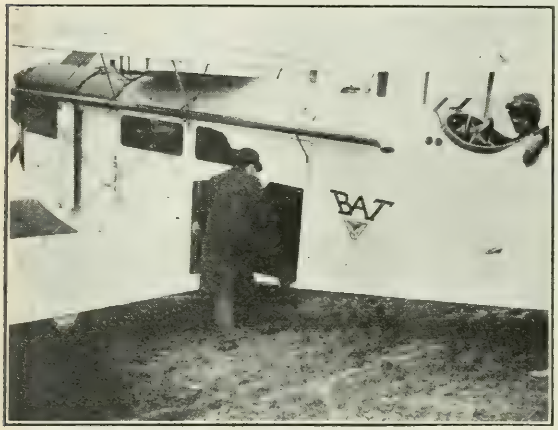


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FIG. 1.

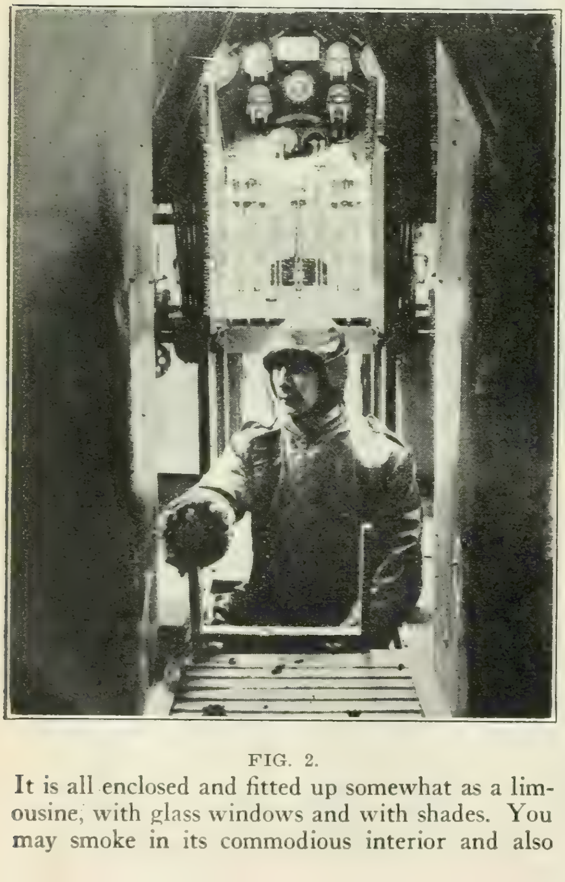


FIG. 2.

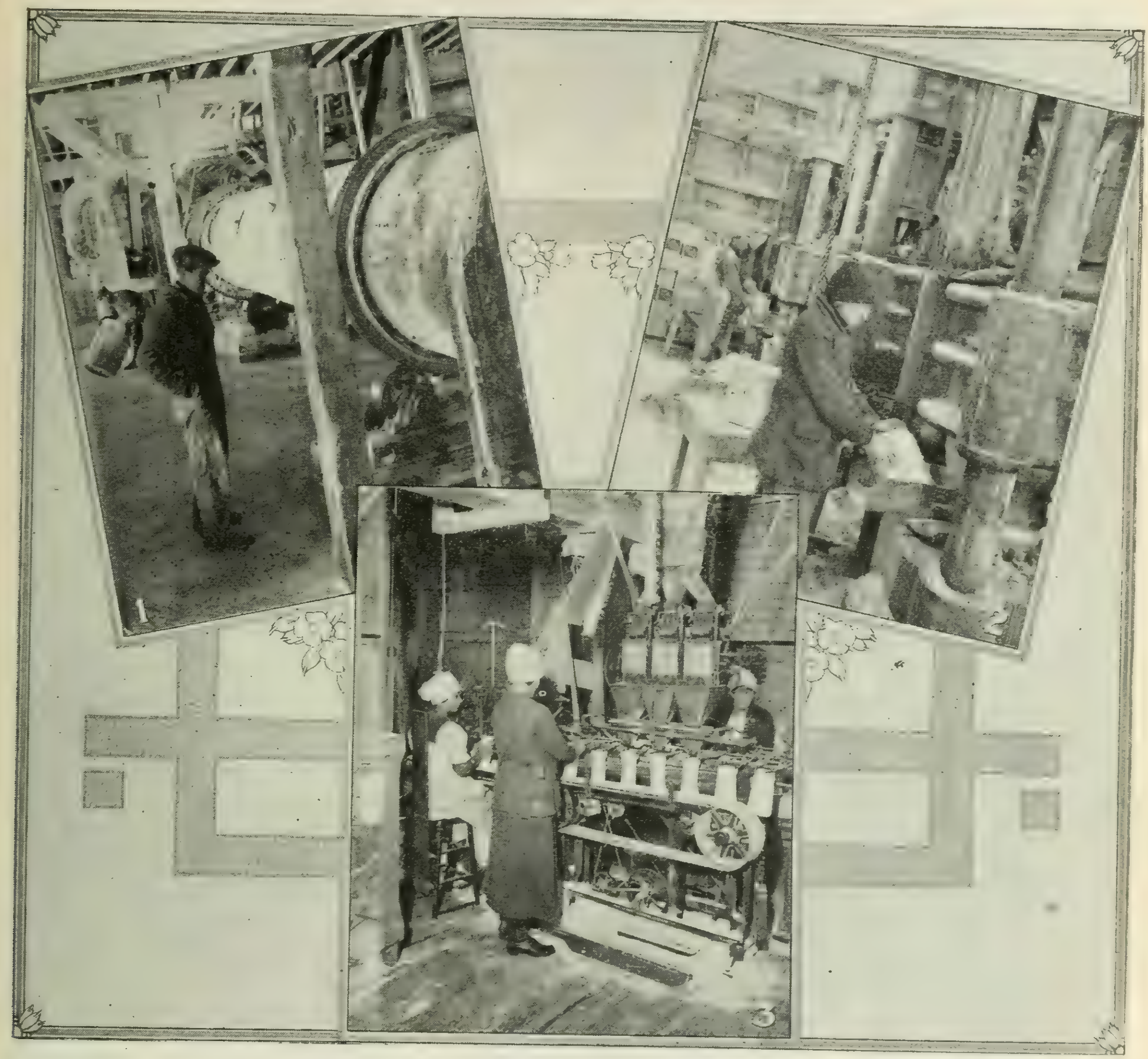
Fig. 2 shows the interior of a Bristol triplane, the latest multi-passenger airplane, which is fitted with a promenade deck. Our photograph shows the entry of a passenger through the pilot's trapdoor, the view having been taken from the interior of the large fuselage. Nowadays English passengers can have their choice of an air limousine all to themselves, or they can join the happy crowd (and "crowd" is the word) in an air omnibus. Civilian flying is now common between England's large cities and many of the suburban business men are going to work in their airplanes, landing just outside city limits where automobiles await them.

The reader may have noted the facts contained in the editorial in the August issue entitled, "The Age of Air Begun in Both Europe and America," which indicates Britain's lead over America.

VOCATIONAL EDUCATION FOR DISABLED SOLDIERS

It is not generally known that the Federal Board for Vocational Education maintains a course designed to prepare disabled soldiers for civil service positions. There are 32 men now studying to qualify themselves for positions under the civil service, and the Board will undertake to prepare any student who so desires, provided he can qualify as physically competent to do the work. Of course there are some regulations regarding these positions and men obviously handicapped cannot expect to hold down jobs where their physical disqualifications are such as to prevent the proper discharge of the duties. But on April 16 the President authorized an amendment to the civil service rules which permits the civil service commission to exempt from the physical requirements established for any position, a disabled and honorably discharged soldier or sailor or marine upon the certification of the Federal Board for Vocational Education that he has been specially trained for and has passed a practical test, demonstrating his physical ability to perform the work sought. Under the law a disabled soldier has a preference on the civil service list.

The following officers have been elected by the Leavenworth & Topeka R. R.; O. B. Goffler, vice-president, Topeka, Kan.; George Hanna, treasurer, Clay Center, Kan.; F. E. Harper, secretary, Leavenworth, Kan.



(Photos Copyright Underwood & Underwood.)

Compressed Air in the Salt Industry

1—EVAPORATION DRUMS IN A HUTCHINSON (KANSAS) REFINERY.
2—COMPRESSING BLOCKS OF SALT AT MILLION-POUND PRESSURE.
3—BAGGING SALT BY MACHINERY.

HERE WE are afforded some glimpses into the great salt industry of the Middle West and West in which compressed air is used extensively, especially in connection with the lifting of brine from the earth's depths to the surface. In certain of the localities, notably in Michigan, the brine is raised to the surface in its native state. In others there are solid salt deposits, which is nevertheless brought up to the surface from the wells in liquid form as hot water is forced through the beds.

This is the case with a refinery at Hutchinson, Kansas, where holes are drilled into the salt beds below the surface and hot water sent down to them to liquefy the salt. It is then pumped up to the drums such as are shown in Picture 1. After evaporation the salt is put into big bins to take the air and to dry out. Then it is screened into the various grades of granulation. The extra fine is put into small bags or boxes for table use, as shown in Picture 3. The coarser grades are packed in bags and barrels for use in meat and fish packing.

Some of the salt is pressed too into 45 pound blocks for the salting of livestock. The photographer reports that the pressure exerted by the pressing apparatus shown in Picture 2 is a million pounds.

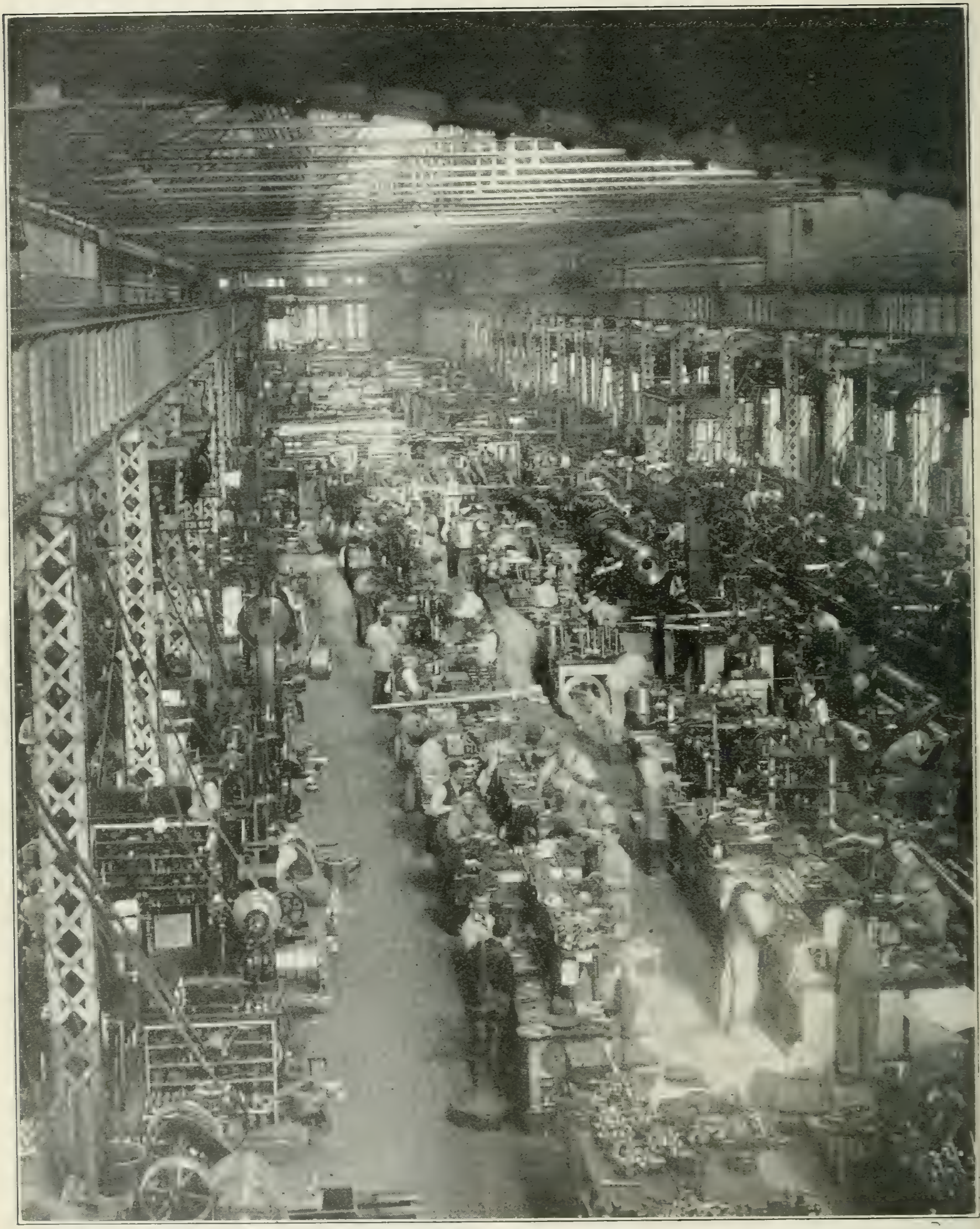


Photo copyright, Underwood & Underwood.

One of Our Big Naval Gun Works

We show here a photograph we should have been prohibited from printing in war-times. It discloses the interior of the great Navy gun works at the arsenal, Washington, D. C. This affords an interesting glimpse of a big modern American gun factory, in which compressed air and pneumatic tools are used for scores of purposes. The photograph only faintly indicates the great size of the building.

3,000 H.P. FOR GIANT TRIPLANE

Great interest has been evidenced in American aviation circles in the giant triplane built in England, the largest thus far constructed, which has a wing spread of 131 feet and is 37 feet high. This machine was constructed for the Royal Air Force, the order having been entered before the signing of the armistice. The original purpose of the craft was that it be utilized in bombing Berlin. The equipment included eight guns and sixteen bombs each weighing 500 pounds.

If utilized for peace purposes, as anticipated, this great airplane will be able to carry more than fifty persons with ease within its fuselage. It was designed by W. G. Tarrant and built by the Tarrant Aircraft Construction Co. Trials of the machine are being made at Farnborough, Surrey, where it was assembled. This same company, it is reported, has designed another machine with a fuselage sixteen feet in diameter, capable of carrying ninety-two passengers.

The big bomber plane has a fuselage seventy-six feet long. The passageway is perfectly clear, there being no wires to obstruct the vision. The three tiers of wide planes are like the decks of a ship. The span of the middle plane is the greatest, measuring 131 feet, the planes above and below being 98 feet in length. The total resistance surface to the air of the three wings is about 5000 square feet.

Propulsion is provided by six Napier engines that develop a total of 3,000 h.p., four of them, of twelve feet, six inches diameter, being two-bladed, driving tractor screws arranged two in line between the middle and lower and middle and upper planes respectively. The remaining two are "pushers," at the back of the machine and are four-bladed screws ten feet, six inches in diameter.

The two pilots for this machine occupy seats up forward in the bow of the fuselage and are a dozen feet ahead of the planes and front propellers so that there are no obstructions to vision.

Aft of the pilots is the engineer's compartment, from which the engine-starting system is set running. Here, too, are the various levers for engine control. Vocal orders can be received from the pilots for starting, but the pilots also have a master control over the engines in case of need. Normally the tanks will carry 1,600 gallons of gasoline, but extra tanks can be carried to insure an extra supply for long flights, such as a trip across the Atlantic, if that is undertaken. The weight of this great triplane, which is said to provide a large safety factor, is eighteen and one-half tons when carrying an average load. This will give some idea of the great power required to lift such a bulk from the ground, this being a military land plane, not a seaplane. In its trial flights the machine carries a crew of five men. The actual performances of this monster of the air will be followed with attention by all aeronauts.

HOPE TO "WEIGH LIGHT"

Prof. W. W. Campbell of the Lick Observatory explains the problem of "weighing light" in his "Solar Eclipse Notes" in the *Publications of the Astronomical Society of the Pacific,* issued at San Francisco. Two British expeditions and at least one American expedition that went out to observe the total eclipse of the sun on May 29, expected to make their main business that of getting data to help solve the problem of weighing light. Prof. Campbell says:

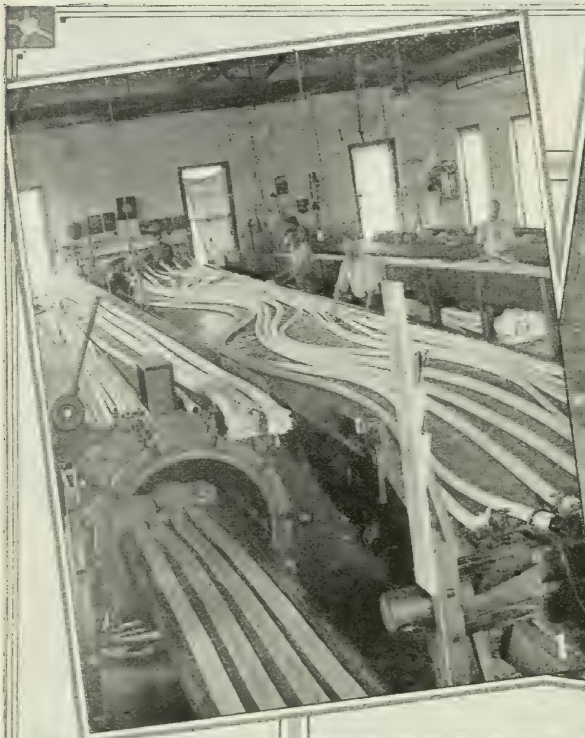
"According to certain hypotheses, light radiations possess mass and are subject to gravitational disturbance. If the hypotheses in one form or another represents the truth, then rays of light proceeding from stars which are seen very nearly in the direction of the sun should be deflected from their straight-line courses, as these rays pass close to the sun and through the sun's gravitational field.

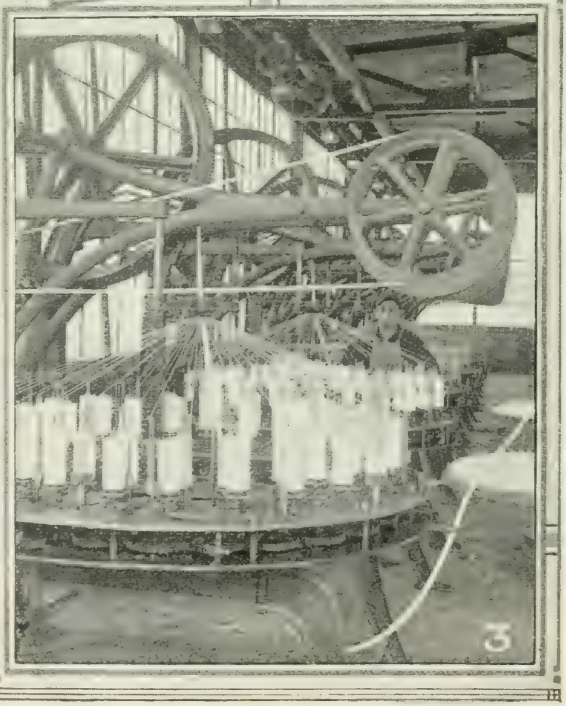
"If a ray of light coming from a star to the eclipse observer just grazes the edge of the sun but without touching the sun, it should be bent from its course in amount 0".87, according to one hypothesis, in twice this amount on another hypothesis, or not at all on a still different hypothesis. The eclipse of May 29 found the sun very favorably situated for the solution of this problem in the northern part of the Hyades cluster. A good number of stars in the photographic field, with the eclipsed sun in the center, may be recorded with an exposure of ten seconds or less. Many eclipses will come and go before another will be so favorable in this regard."

At this writing we have no news from either the American or the British expeditions. Much other interesting scientific data may be expected when results of the eclipse observations are made known.

The faithful 'tin derby,' which served so well on the battlefields of France, has now been drafted for peace service. The War Department suggests that the helmets can be used to advantage in occupations where there is danger of head injuries from falling objects. A hot rivet landing on a helmet may make some returned soldier beneath it think of old times, but it will simply bounce off and go on its way rejoicing without doing any damage.

Making Rubber Hose for Compressed Air Use





(Photo Copyright Underwood & Underwood.)

1—HOSE LAID OUT IN THE VULCANIZING ROOM OF A RUBBER FACTORY.

2—TURNING OUT SMALL AIR AND GAS HOSE.

3—BRAIDING THE OUTSIDE COTTON COVERING FOR HIGH-PRESSURE HOSE.

The above views were taken in a large rubber factory for COMPRESSED AIR MAGAZINE to illustrate the processes of making hose for the compressed air and pneumatic tool industries. Millions of feet of air hose a year are purchased in the American market, and the demand is constantly increasing along with the growth of the compressed air industry.

By far the largest aggregation of centrifugal pumping machinery for water-works purposes is that of Chicago, which includes 16 plants having a combined capacity of about 400,000,000 gal. per day, with over 60% of the volume lifted electrically.

PNEUMATIC DISTRIBUTION OF FUEL OIL

The simple and sensible arrangement here shown for the control of fuel oil distribution by means of compressed air was presented in a recent issue of *Engineernig and Mining Journal.* The assurance of its entire success in practice would seem to have been entirely superfluous. In the sketch here reproduced some necessary pipe unions seem to have been forgotten:

The equipment consists of three pressure-tight storage tanks. The high pressure air (50 to 60 lb.) is piped to these tanks and is controlled by the valves *A, B,* and *C.* Valves *D, E,* and *F* (when *A, B,* and *C* are closed), permit the exhaustion of the pressure from any tank whenever it is desired to refill that tank. In addition, each of these valves serves as an overflow in case a tank becomes too full. The supply of oil from the three tanks to the service line is controlled by the valves *H, I* and *J.* The valves *K, L,* and *M* are used in the filling or transferring of oil from one to the other of their respective tanks. The valve *N* admits oil to the manifold from the main storage or from an oil car. The valve *O* may be used for drainage or cleaning of lines. A few examples of the manipulation of the system will make its advantages more apparent:

1. To fill Tank 1 from main supply: Open *D,* make sure *A* and *H* are closed, and allow air pressure in tank to exhaust itself. Then open *N* and *K* and allow tank to fill by gage or until oil overflows at *D;* if there is no gage, then close *D, K,* and *N.*

2. To supply service line from No. 1 which has just been filled: Open *A* and then *H.*

3. To "change over" when No. 1 tank is nearly empty to No. 2, which is full, without interrupting the supply to line: Open *B,* making sure *E* is closed. Then open *I,* after which close *H* and *A.*

4. To transfer oil from No. 3 to No. 1 while supplying service line from No. 2: Open *B*, making sure *E* is closed, then open *I,* thus supplying service line from No. 2. Open *D,* making sure *A* is closed, and exhaust pressure from No. 1; then open *C,* making sure *F* is closed; then open *M* and *K* and allow No. 1 to fill from No. 3. When No. 1 is filled, close *D*, then *K, M,* and *C.*

5. To fill No. 1 from No. 3 while supplying service line from No. 3: Open *C,* making sure *F* is closed; then open *J,* thus supplying service line from No. 3. Open *D,* making sure *A* is closed, and exhaust pressure from No. 1. Then open *K* and open *M* as far as possible without lowering the service-line pressure at gage *P* below the minimum required, and allow No. 1 to fill from No. 3. When No. 1 is filled, close *D*, then *K* and *M*.

6. To partly fill only one of the three tanks from either of the two others, without having an employee watching it, e.g. to fill No. 1 from No. 3 while supplying service line from No. 3; Open *C,* after closing *F,* then open *J.* Open *D, A* remaining closed. Open *H* as far as possible without lowering the pressure on service line below the required minimum, and after the air pressure has been exhausted from No. 1 tank, close exhaust valve *D* and allow No. 1 tank to fill, compressing the air in No. 1 tank from atmospheric pressure to the same pressure as No. 3 tank, thus having No. 1 tank almost full of oil with air pressure high enough to use immediately, and no possibility of an overflow.

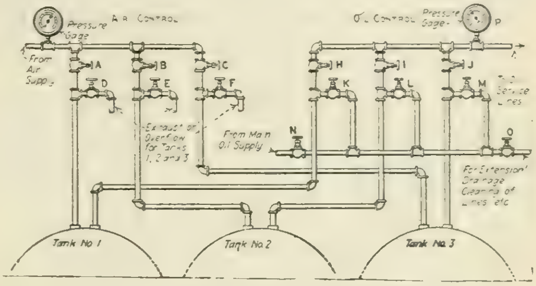


DIAGRAM SHOWING SYSTEM.

This system of distribution is not only fundamentally simple, but covers every contingency and insures an uninterrupted flow to the service lines. It can be made up of standard pipe fittings, and is so arranged that it may be readily added to or extended.

William Wharton, Jr., & Co., Inc., at Easton, Pa., a subsidiary of the Taylor-Wharton Iron & Steel Co., is installing tools and equipment for the production of seamless steel gas cylinders used for the transportation of compressed gases.

The coefficient of heat transference in condensers, or the number of heat units transferred per hour through 1 sq. ft. of metallic condenser wall when the temperature of the steam is 1 deg. F. higher than that of the water, for various metals of the usual thickness or about 0.04 in., is fairly well established for ideal conditions and may be given as 18,430 for brass, 61,500 for copper, 11,270 for iron, 5,740 for zinc, 11,050 for tin and 2,660 for aluminum. In everyday practice, however, little difference is observed between copper and iron tubes.

Notes of Industry

The Eureka Vacuum Cleaner Company, Detroit, has erected a new plant which it claims is the largest exclusive vacuum cleaner factory in the world. The building is three stories, covering an area of over 19,000 sq. ft. and over 60,000 ft. of floor space is provided. The plant is equipped with a vast amount of up-to-date machinery which will make possible the production of 1,000 electric cleaners per day.

H. Hamada, president of the Tokoyo Gear Works, Tokoyo, Japan, is visiting this country for purpose of investigating and purchasing machinery and machine tools to be installed in his works in Japan. Mr. Hamada's American address is Hotel Bretton Hall, New York City.

During the daylight saving season last year, the Edison Electric Illuminating Co. of Boston saved 4420 long tons of coal because of the extra hour of daylight utilized by turning the clock one hour forward. The decrease in kilowatt-hours from this cause was 5,000,000, representing a loss of revenue of about $350,000.

The Carnegie Institute of Technology, Pittsburgh, Pa., has recast its four-year course in mining engineering and has established a two-year course in coal mining. The latter course will be open to men who have a common school education and two years' experience in or about the mines. The changes are the result of a conference held a few weeks ago between 25 representatives of the coal mining industry in western Pennsylvania and President Hamerschlag. The idea is to attract more trained men to the mines and to give to the young men now employed an opportunity to advance themselves to more responsible positions. A board of mine operators and engineers is to be created to serve in an advisory capacity and the course will also have the cooperation of the United States Bureau of Mines.

The performance of a heating furnace utilizing a fuel composed of pitch and creosote is reported in the engineering supplement of London *Times*. Two tons of steel billets were heated in 55 to 60 min. to 2000 deg. Fahr. using about 16 gal. of the fuel per hour. The internal size of the furnace is 10x5x3.5 ft. Equal weights of creosote and pitch form the mixture, which is kept at a temperature of 180 deg. Fahr., and, strained through a wire gauze strainer of 40 meshes to the inch, is pumped through an injector type of burner.

During the threshing season Indiana reported that gas masks were in demand for threshing and shipping wheat infected with the Australian "take-all." All grain was so infected with the fumes of formaldehyde that the endurance of workers was tested. Wheat from infected districts is held by the United States Grain Corporation at New York for investigation.

Interest has been created throughout business circles in the United States by the declaration in Congress of Representative Moon that it is possible to establish one-cent letter postage and yet permit the Postoffice Department to earn a surplus of $25,000,000 a year, provided other classes of mail are made to pay cost of handling.

The Commercial Travelers of America, some 30,000 strong, have declared war on promoters of fraudulent stocks, and have announced their intention of carrying a warning to every city, town and village in the territories they cover against fictitious stocks and get-rich-quick investments. They are also to make war on dealers that make a practice of buying War Savings Stamps and Liberty Bonds, below their real value, from unsophisticated persons.

Legislation is sought permitting the Navy Department to continue handling commercial radio messages to and from ships at sea and between shore stations. Secretary Daniels has declared that "an intolerable situation in the business world" is threatened because of the inadequacy of the commercial communication systems of wireless. Aside from the American Marconi Company, which is of course controlled from abroad, there is now no great American wireless corporation providing general service.

The United States Geological Survey announces that the Black Hills Mining District of South Dakota produced $6,565,209 in gold and 159,246 ounces of silver in 1918. The Survey is also authority for the statement that the value of precious stones produced in the United States annually since the beginning of the twentieth century has been about one-third of a million dollars. Since 1914 the annual value of output has dropped considerably.

There are 200 engineering societies in the United States, with a total membership of 100,000, the annual dues amounting to $1,000,000. There are possibly 200 other societies more or less connected with engineering, and having many engineers as members. Probably 100,000 other engineers do not belong to any society.

There have been rumors that the railroads would be returned to private control on October 1, such rumors having been the result of plans to have the Congress enact legislation at that time. Information from Washington as we go to press is that the President himself has given no consideration to the railroad problem since his return. Advocates of the Plumb bill are said to be informed that there will be no return of the railroads before January 1 next.

The high cost of living has become a most acute political question in all European countries. It is rapidly becoming such here. Observers of the materials and commodities markets in this country, who have been making dispassionate and careful calculations, are of opinion that in America a rising rather than a lowering of the scale of prices is to be anticipated, unless a wise course of action is taken to prevent it.

Britishers are about to raise a fund of some millions in the United States for the relief of British subjects who left here to fight and who will not be able to get relief from their home government. Other interests, we learn from Washington, are to raise a heavy fund here for the relief of Germans in Germany.

The Edge bill was reported favorably, as was an amendment putting the Federal Reserve banking system at the service of the new export banks, by enabling the latter to rediscount their paper. This amendment was added at the request of the Federal Reserve Board, and is virtually a substitute for the system advocated by Senator Owen.

The Director of the Air Service announces that there will be offered at low prices to colleges and schools desiring to teach aeronautical engineering, an accumulation of miscellaneous airplane motors and unserviceable airplanes that were used for instruction purposes.

It is reported from San Bernardino, Cal., that no less than 11,500 men, women and children are now employed in canneries of this interior district of Southern California.

The Carnegie Steel Company is canvassing its employes at Youngstown, according to the *Wall Street Journal,* to ascertain their views on coöperation between company and employe in the building of homes. The United States Steel Corporation is fathering a movement for workmen's homes through its real estate subsidiary.

The United States Shipping Board is to build two gigantic ocean racers larger and swifter than anything now afloat. They will be 1,000 feet in length, 102 feet in beam and will make 30 nautical miles an hour, or 34 land miles an hour, enabling them to make the transatlantic crossing in four days. They will be oil burners with steam turbines driving four screw propellers. Two other ships of the same type are also projected. Fort Pond Bay, at the upper end of Long Island, is under consideration as the terminal for these great ships.

The first "strike" of aviators in history was called off on July 25 pending a settlement of the differences between the aerial mail pilots and the United States Postoffice Department. Pilots objected to going aloft against their best judgment in bad flying weather and also asked for minimum pay of $3,600 a year.

What was said to be the largest airplane engine in the world was recently put under its first test at Wolverhampton, England. It was reported to be of 1,000 nominal horse power and to develop about 900 horse power at normal working speeds.

A news dispatch cabled from London declares that the successful trips of the British dirigible airship, R-34, have prompted American and British financiers to consider the formation of a $30,000,000 transatlantic corporation to be called Aglo-American Airships, Ltd.

The State Department comments on the existence of large and important oil deposits in the vicinity of Mapimi, State of Durango, Mexico, a discovery believed in Mexico City to be the result of prospecting operations.

Uncensored wireless and postal communication with Germany began in July. Soldiers' mail arriving from France was still being censored by the army on Aug. 1. It is understood that all passport regulations of wartime character will be lifted by the State Department on November 15. The world is gradually getting back to peacetime normal, despite economic uneasiness.

BLASTING PRACTICE IN JOPLIN ZINC DISTRICT

IN THE JOPLIN zinc district, embracing the territory adjacent to Joplin, Mo., the Webb City sheet-ground deposits and the mines of Ottawa County, Oklahoma, and Southeastern Kansas, the ore bodies present unusual conditions, which affect and determine the drilling and blasting. An interesting description of the methods employed in this district is given by Mr. R. H. Sumner in the *Du Pont Magazine*.

In describing the blasting practice of this district, the mines may be divided into two classes, namely, the "sheet ground," which embraces most of the Joplin-Webb City section, and the irregular deposits or "runs" which apply to most of the Oklahoma-Kansas mines.

The ore deposits of the "sheet ground" lie in horizontal sheets of a generally uniform thickness and extend over large areas. The mineral content is more or less uniform, the zinc and lead sulfids occurring imbedded between the layers of chert and in crevices or small openings.

Shafts, usually 5 by 7 ft., are sunk a depth of from 175 to 300 ft. to the bottom of the ore body. Electric blasting is now used almost entirely for shaft work. The center cut system is used, usually with four cut holes, four relief holes and four corner or squaring up holes. Instantaneous electric detonators are used in the cut holes; first delay electric igniters in the relief holes and second delays in the corner holes.

Gelatin dynamite of 35 per cent. and 40 per cent. strength is used in charging the holes. When charging is complete, the shots are all connected in series and fired by blasting machine after all men are well away from the shaft.

Drifts are run out from the shaft into the ore body in all directions, except, of course, in the narrow "run" deposits where the drifts follow the ore. Pillars from 20 to 40 ft. in diameter are left to support the roof, spaced according to the height of the ore body and the condition of the overlying material.

Air-hammer drills with water attachment are used almost exclusively, although there are some piston drills. The starting bit is from 2½ to 3 in., guaged every 2 ft. down to from 1¼ to 1½ in. The hard, brittle flint wears steel exceedingly fast. This fact along with the open ground, drilling into crevices and changing ground makes drilling difficult and affects the blasting practice to a great degree. Often a well-balanced round is spoiled by drilling into an unforeseen opening, and, again, the bore hole must be placed at a disadvantage because of a known crevice or pocket. The character of the material blasted is responsible for the practice of chambering, locally known as "squibbing," the bore holes, so that a greater quantity of explosives can be charged, and hence more tonnage realized per foot of drilling. Experience has demonstrated that the increased quantity of explosives used is often more than compensated for by the saving in drill steel and labor costs.

Breaking the ore in the headings may be divided into three classes:

DRILLING AND BLASTING IN LOW ORE FACES

Where the ore face is low (see Fig. 1), from 7 to 12 ft., the round of holes is drilled so as to blast out the entire face at one setting.

From four to eight holes, 8 to 12 ft. deep, are drilled per round. This class applies chiefly to sheet ground deposits.

Five holes is an average round with two breast holes, two roof holes and one lifter, locally called a "stope" hole. This is somewhat confusing as there is no differentiation in momenclature of the real "stope" hole and the bottom hole in the heading or cutting in round. A round of holes of this kind is drilled ordinarily a little deeper than the height of the heading being driven and are burdened so that the round will break almost as much across the toe as the depth of the hole. The holes are chambered and blown out by the drill man and, later, charged and fired by the powder man.

In higher faces of ore (see Fig. 2), from 12 to 70 ft, the heading is driven at the top of the ore body, with machine mounted on 6 to 8 ft. posts. The material left on the bench below is taken up by underhand stoping in one or more benches, depending on the vertical extent of the ore. The heading is carried ahead of the stope just far enough to permit the machine men to work. In this way the blasted material from the heading rolls down the stope by gravity and obviates shoveling in the heading. From five to eight holes, 6 to 10 ft. deep, are drilled per round in the heading.

After drilling is completed, the machine man chambers, when his judgment or that of the powder man indicates, with from 1 to 2½ lb. of explosives. Each hole is then blown out with a blower attached to the compressed air hose, leaving the holes clean and free from the cushioning effect of dust or rock particles. In some mines where the material is easier breaking, chambering is found unnecessary in the heading holes.

The horizontal holes (stope holes) driven in the bench below are 12 to 14 ft. deep and carry a burden from 10 to 12 ft. A stope hole of this kind fairly squared up on the collar will break from 150 to 200 tons.

Stope holes are chambered once, twice or more times as the burden on the hole and hardness of material may demand. The best judgment of the mine foreman, powder man and machine man must be used in chambering stope holes, particularly in the irregular deposits of Oklahoma, for one hole may be bottomed in a solid chert or dolomite boulder, while the next may be in a soft ore pocket or even in a cave. The size of the pocket governs the quantity of explosives charged, and it is difficult to secure approximately just the right size chamber. Because of this variable condition, a hole will sometimes be lost, due to underloading, and, again, a hole will be charged with a much greater quantity than is actually needed. It also happens in open crevicy ground that an opening near the toe of the hole will cause the explosive force of the gases generated by detonation to be uselessly dissipated.

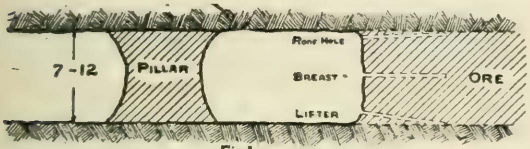


Fig. 1

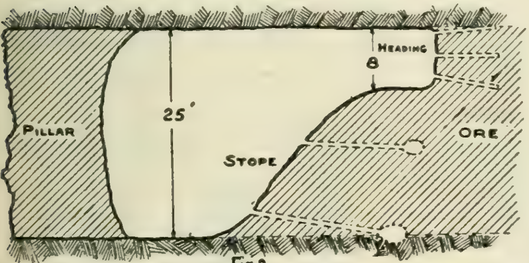


Fig. 2

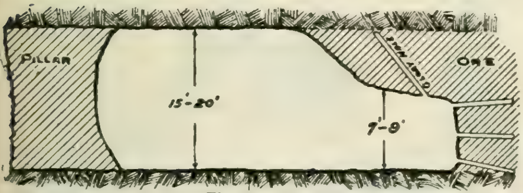


Fig. 3

MODIFIED OVERHEAD STOPING

When the ore face is in material of sufficient hardness, so that the overhanging rock will not slab or fall down (see Fig. 3), a modified overhead stoping is economically used. It is almost the reverse of the method just described, the heading being advanced at the bottom of the ore body on a 6 to 8 ft. machine post. When the heading is advanced from 15 to 25 ft. ahead of the overhanging material, holes called "glory holes" are drilled 10 to 12 ft. deep slanting backward and upward 45 degrees from the face. The heading holes and glory holes are chambered and prepared for charging as described above.

EXPLOSIVES USED

About every kind and strength of dynamite has been used, from 17 per cent. "straight" nitroglycerine up to 80 per cent. gelatin dynamite. The tendency the last two years has been toward the use of lower grade dynamites with a stronger detonator. The results produced indicate this to be good practice, provided the grade is not too low, causing the miners to do more chambering. The extra grade dynamites of 30 per cent. and 33 per cent. have proved very efficient when used with a No. 8 detonator.

In wet or close work, when ventilation is poor, in shaft sinking, raises or drifts, gelatin dynamites are used. In open stope work, 30 per cent. and 35 per cent. gelatin will usually meet all requirements.

Since the introduction of lower grade "extra" and gelatin dynamites, fatal accidents have been materially reduced, due to these explosives being more insensitive to shock than the straight dynamites. There still exists, however, in some mines, the bad practices of "short fusing" on the chambering, shots, and chambering on shift. Those practices go hand in hand, as the object of "short fusing" is to shorten the time wasted by all the men within range of the shot.

LOADING BORE HOLES

The charging of the bore holes is usually done by a powder crew after the drilling, chambering and blowing out of the holes is completed by the drill man. The dynamite cartridges are slit and stuck on a copper spike inserted into the end of the wooden tamping bar, held on by a copper ferule, which also serves to keep the bar from being quickly worn by the sharp projecting points of chert.

The primer cartridge is usually placed near the top of the charge with two or three cartridges tamped on top. Fuse is cut in 8 or 10 ft. lengths and trimmed at least 6 in. to effect the proper rotation of shots. Tamping material or stemming is rarely used, and there are some logical reasons for this fact. First, there is an absence of a good tamping material; the best available is to fill tamping bags with fine tailings from the concentration tables. If these are absolutely dry they make very poor tamping, and if damp the bag breaks and is pushed into the rough bore hole with attendant difficulties. Secondly, in the general practice there are always some holes nearby that are heavily burdened near the collar as on the toe. If the material is soft or crevicy at the toe and the hole is tamped or stemmed there is a good chance of shooting out the back end and leaving the front part of the hole "hanging in the wall."

The primer cartridge is almost always made by lacing the fuse transversely through the cartridge and inserting the cap obliquely into the side. A safer and more efficient way is to tie the fuse to the cartridge with a piece of string and eliminate the liability of igniting the charge from a spit size of the fuse.

HIGH EFFICIENCY OF COMPRESSED AIR FOR BLOWING

There is probably no employment of compressed air, at the familiar working pressures of six or seven atmospheres, which in actual practice shows on the one hand a more wasteful and on the other hand a more economical use than for blowing blacksmith fires or metal furnaces. There is also no topic to which our correspondence shows more frequent reference. The following views of Mr. A. C. Delfield in the *American Machinist* will be welcomed by many readers for the clear and precise information it gives upon this interesting subject.

The use of compressed air for blowing fires in drill sharpening and blacksmith shops, steel fabricating plants, car shops, shipyards, structural shops, bridge and building erection, etc., is common practice. In fact wherever compressed air is available its convenience generally leads to its use for this purpose. It has frequently escaped attention that it is extremely bad practice to compress air to 100 lb. or other high pressure and then throttle it down to a fraction of an ounce, which is all that is necessary for blowing a fire if the necessary volume is supplied. This fact has lately been brought sharply to attention by the intensive shipbuilding program in this country which called for air plants of unusual size. The United States Shipping Board has investigated the subject thoroughly and in the published results issued by the Steel Ship Division it is stated as follows:

"The average air used by a rivet furnace runs from 20 to 40 cu.ft. per minute. The use of high pressure air in a great majority of shipyards is not only overtaxing the capacity of the air compressor plants in many cases, but is resulting in a waste of power that does not seem to have been generally appreciated. A large percentage of high pressure air now used for this purpose can be saved by the application of a jet siphon. The high pressure air passing through the nozzle of the siphon draws in a liberal quantity of free air which is mixed with the initial air. The percentage of induced free air taken in depends entirely on the design of the siphon blower, and runs from 30% in some of the crude arrangements which have been improvised by some of the shipyards to 75% or 80% for the best standard makes of siphons which have been carefully tested out by the Standard Practice Branch of the Emergency Fleet Corporation." (Since the above results were reported, the blower described in this article, Fig. 1, has exceeded 95% of free air induced, as shown by data below.)

What a blower of this type means in dollars and cents is readily determined. The cost of compressed air per 1,000 ft. ranges from four to ten cents, depending on the location and size of the plant, cost of power, etc. A fair average for a good sized plant is six cents per 1,000 ft. This covers the coal or electricity purchased, labor, oil, supplies, etc. and fixed capital charges. A single small rivet-heating forge at an average of 30 ft. per minute, or 1800 ft. per hour, would use 14,400 ft. in eight hours and the cost at six cents per 1,000 ft. would be 86.4 cents per eight-hour shift. In 25 working days of eight hours each, this would amount to $21.60 a month or $259 a year for one forge. Multiplying this by several hundred forges will give a very impressive total. The blower here described and illustrated will operate one of these forges on an average of 2 ft. of air per minute, or 960 ft. in eight hours at a cost of 5.76 cents a day, or $1.44 a month, a clear saving of over $20 a month per forge.

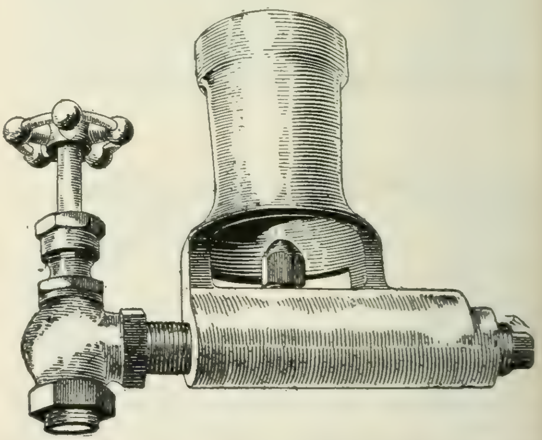


FIG. 1—SIPHON FORGE BLOWER AND NEEDLE VALVE.

The construction of this blower as shown in Fig. 2 comprises a needle valve *V*, a jet chamber *C* with strainer *S*, a high-pressure-jet nozzle *N*, with orifice proportioned to give a high velocity to the issuing compressed air, and a bell-mouth blast tube *B* to induce free air and transfer the kinetic energy of the small high-pressure jet to a large volume of air at a low pressure. The orifice of the high-pressure jet at its smallest section is 1-16 in. in diameter. The volume flowing depends on the pressure admitted by the needle valve into the jet chamber. When starting a fire or bringing up a heat quickly, full pressure may be admitted, but in normal use the pressure acting on the jet needs to be only about 20 lb. or less. Tests on this blower give the following results:

Pressure in Jet Chamber C, Lb.	High Pressure Air Consumed Cu.Ft. Free Air per Minute	Draft in In. of Water Pressure	Total Volume Air Delivered, Cu.Ft. per Minute	Ratio Air Delivered to air Consumed
80	5.3	4.25	77.3	14.3
60	4.2	3.35	68.7	16.0
40	3.1	2.35	57.5	18.5
20	1.9	1.2	41.1	21.6

To secure this high economy the hole in the high-pressure jet must be small and properly formed, and all the proportions and arrangements of the blower worked out to the best advantage. A necessary feature is the strainer in the chamber *C* through which the high pressure air must pass before reaching the jet nozzle. This prevents the small jet orifice becoming choked with grit, pipe scale or fragments of rubber from the air hose, which are always present in compressed-air lines.

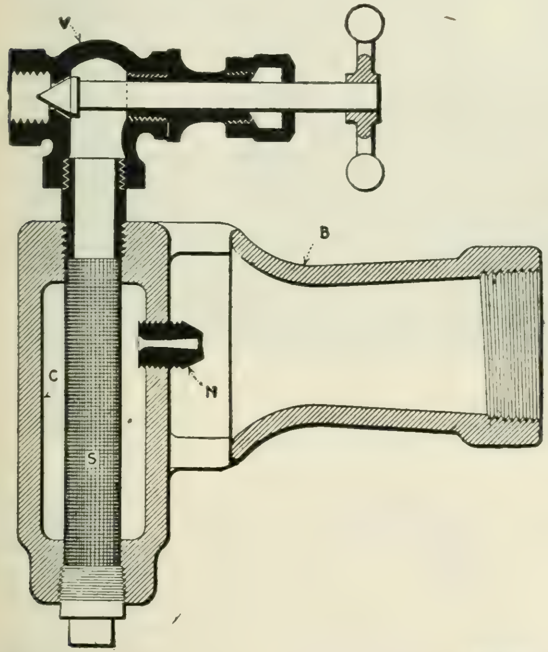


FIG. 2—CONSTRUCTION DETAILS OF BLOWERS.

The above data are obtained from tests on a "wind-box" and not directly on a forge, as it is very difficult to get a measurement of the low-pressure air going to the forge. It is possible, however, to measure the amount of air used when it is all taken from the compressed-air line and a comparison can then be made on the same fire under the same conditions of fuel bed and draft, which will give a direct comparison of the two methods. A test of this kind was made on a small cast-iron rivet forge used in a shipyard. This forge has a grate 10 in. in diameter and the fire pot is of the usual flaring form about 12 in. inside diameter at the top. The thickness of fuel bed was 6 in. of pea coal. Air was first taken from the high-pressure air hose, no free air being induced, and the flow measured with an air meter.

Readings of the static draft in the ash pit under the grate were taken simultaneously with the meter readings. The blower was then connected and the needle valve adjusted so as to give the same draft readings as before. The difference between the high pressure used in this case and when blowing the fire direct without the blower, is a measure of the air induced by the blower under actual conditions of forge operation.

Draft in Ash. Pit, In. of Water Pressure	Cu.ft. Free Air per Minute Taken from High Pressure Line		Efficiency of Blower
	Without Blower	With Blower	
0.35	36.4	1.35	96.3%
0.7	52.4	2.52	95.2
1.35	59.3	4.76	92.0

It was noted that with 0.35 in. of draft there was a good slow fire, with 0.7 in. draft there was an active hot fire of rather greater intensity than the average required, and with 1.35 in. draft there was a very intense fire such as would be rarely required. As nearly as can be determined an average working condition would be 0.5 in. of draft, 45 cu.ft. free air per minute required without blower, 1.93 cu.ft. of high-pressure air required with blower, and efficiency of blower under this condition 96%; in other words only 4% of the necessary air for blowing the fire has to be drawn from the compressed air supply, the remaining 96% being induced from the free atmosphere.

What is considered to be the largest individual transaction in linen in England was the sale of 40,000,000 yards of linen intended for use on airplane wings by the Aircraft Dispersal Department, of the British Government. The price paid for the linen is given as £4,000,000.

A new mineral has been discovered in Siberia. The discovery was made by a hunter on the shore of Lake Balkash, and the mineral has been named Balkashite. It has the appearance of dark-brown hard rubber, and when ignited it burns with a strong flame, leaving about 2 per cent. ash. When placed in water it becomes a mass very much like paraffine.

Compressed Air Equipment in Department of Engineering, Johns Hopkins University, Baltimore, Md., used for demonstration and experimental purposes

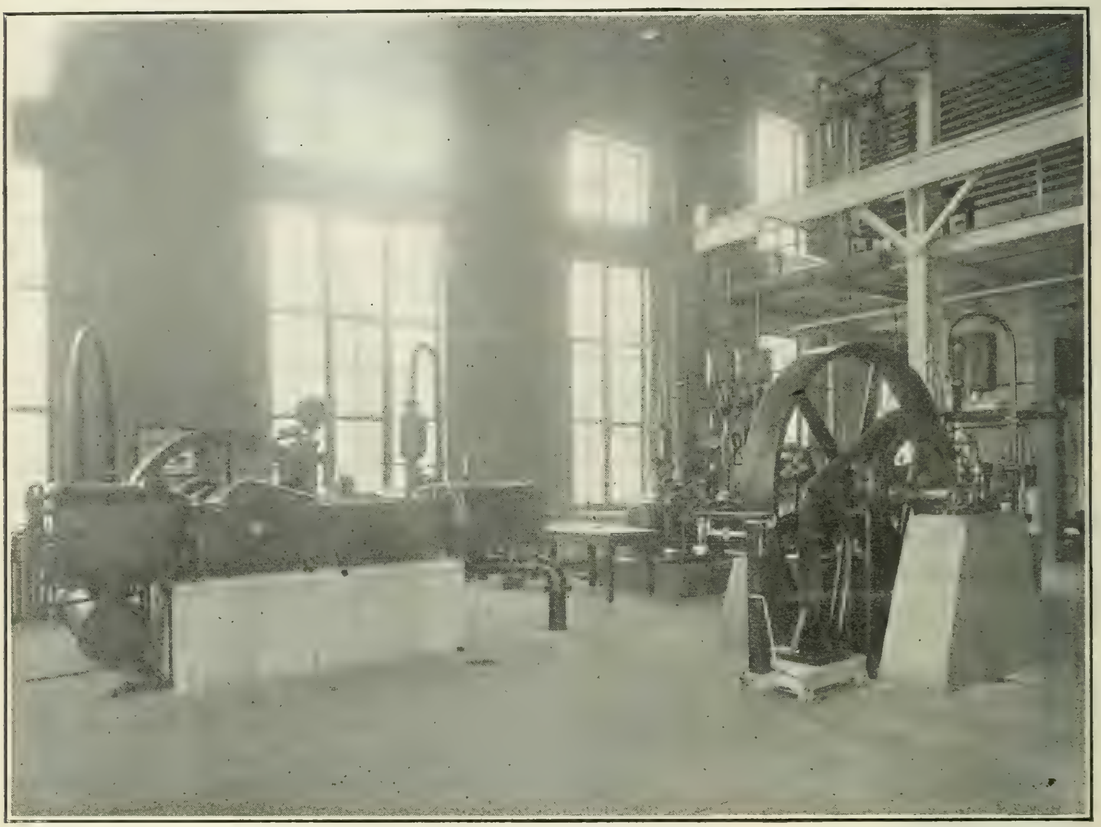


Photo by Alfred Waldeck, Baltimore, by courtesy of Johns Hopkins University.

IMPERIAL TYPE X P V INGERSOLL-RAND COMPRESSOR, PISTON VALVE STEAM ENGINE DRIVEN. INSTALLATION AT JOHNS HOPKINS UNIVERSITY.

THE ABOVE picture, provided through Professor J. C. Smallwood of the Department of Engineering, Johns Hopkins University, shows an installation of an Ingersoll-Rand Imperial Type XPV, piston-valve, steam-driven air compressor, which is used for the benefit of students at the University. The compressor is 9x18 steam, 16x10 air and 14″ stroke, and is fully equipped, Professor Smallwood writes, for measuring the steam consumption and other items of performance. It has eight indicator cocks and when undergoing test eight indicators are used.

The air is discharged into a receiver on the floor below, from which it emerges through an orifice, by which means the quantity of air is measured. The receiver is large enough to maintain a practically constant pressure behind the orifice. Professor Smallwood says:

"It was the original intention to test a number of orifices under high pressures with a view to the determining of the coefficients, the standard of measurement being the Thomas airmeter which is perhaps the most accurate instrument of its kind. The war, however, interrupted this line of research, as well as a number of similar lines on this unit. It is likely in the near future some additional compressed air machinery will be installed, which will be supplied by this compressor and will be fitted with special testing apparatus."

J. D. Haydon, roadmaster of the Louisville & Nashville R. R., with headquarters at Louisville, Ky., has been appointed superintendent of the Atlanta division, with headquarters at Etowah, Tenn., succeeding A. P. Bayless, resigned.

CONSTANT VOLUME AIR REGULATOR FOR TURBO-BLOWER

Brower, Boveri & Company, London, have lately put on the market an automatic regulator for turbo-blowers the special features claimed for which are that it can be used with all pressures, that it is entirely enclosed, is perfectly stable and is not subject to wear. It influences directly the oil pressure under the piston controlling the steam regulating valve of the driving turbine, and hence the speed of the turbo-blower.

The cut here reproduced from *Iron and Coal Trades Review* shows diagramatically the regulator as applied to a Brower-Boveri steam turbine. In a turbine of this design the governor operates through the sleeve F (directly connected to the link gear of governor C), increasing or decreasing the opening of the outlet port in the governor oil system, and thus the oil pressure varies under the piston connected to the main turbine throttle valve, whose opening is proportional to the oil pressure. A rapid pulsation in the oil pressure, in order to increase the sensitiveness of the whole governing gear, is obtained through the beveling of sleeve F., shown in the figure.

The arrangement of the automatic air regulator is as follows: On the regulator spindle there is fixed a diaphragm piston E (supported by the spring G), which divides the casing surrounding it into two compartments. These are connected by means of the pipes 4 and 5 in which resultant pressures are obtained by means of the diaphragm in the air main, the difference between them depending directly upon the quantity of air delivered. The resultant pressure acting upon the diaphragm E causes a movement which is directly transmitted to the plunger of the oil relay L, which is a part of the oil-governing gear of the turbine *via* the pipes 1 and 2, so that the pressure of the oil in the governing system of the turbine depends upon the amount of the displacement of the diaphragm E.

The operation of the regulator is as follows: Should an increase occur in the volume of air delivered, there will result an increased pressure above the diaphragm E, and the resulting movement communicates itself (against the resistance of spring G) to the plunger or relay L, thus increasing the area of the oil-outlet passage and allowing more oil to pass. The oil pressure consequently diminishes, and the throttle valve of the turbine will close by an amount which corresponds to the difference in pressure across diaphragm E, and the turbine speed will be reduced until the original volume of air is restored. Conversely, when there is a reduction in the air volume delivered by the blower the process will be reversed.

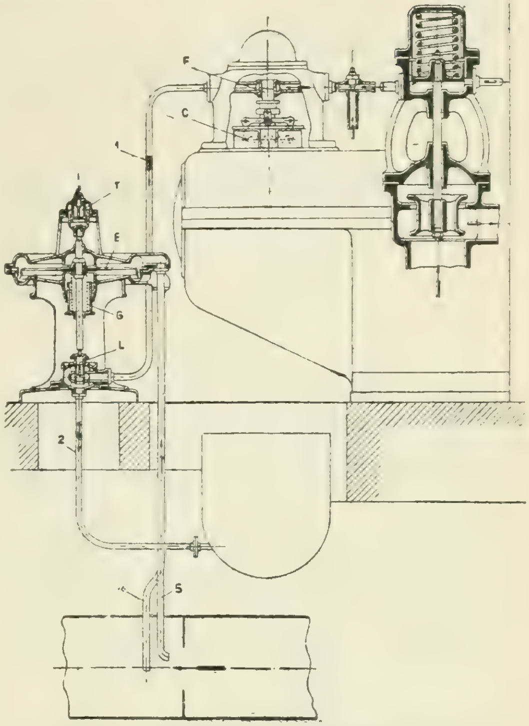


DIAGRAM SHOWING OPERATION OF AIR REGULATOR.

HIGH COST OF AIR LEAKAGE ON RAILROAD TRAINS

It is not easy to realize the volume of air lost by leakage in long railroad trains when running. It may be said that less than one or two per cent. of the air compressed is used for the brakes while all the rest is lost. On long runs of freight trains the brakes may be operated only three or four times in ten hours, while the leakage never stops. A report of the Master Car Builders' Association states:

"A 100-car train requires 180 cu. ft. of air, and with a four pound per minute leakage (which is not unusual), the compressor has to pump 84 cu. ft. per min. additional. This is equal to 2,880 cu. ft. per hour, which requires 82 pounds of coal per hour and using 574 pounds of water. A leakage of five or six pounds per min, is not uncommon, and a conservative estimate of coal consumed is 860 to 1,720 pounds for 10 hours. On many trains the leakage in five minutes is equal to the air necessary to make a full service application."

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W. L. SAUNDERS, *Editor*
FRANK RICHARDS, *Technical Editor* FRANCIS JUDSON TIETSORT, *Managing Editor*
CHARLES A. HIRSCHBERG, *Business Manager*

Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

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REALIZING OUR NEW PLACE IN A WORLD OF WONDERS

FIVE YEARS ago from the date we write, July 28th, the greatest war of all history began. It brought events and results in its train that the wildest dreamer could not have forecasted. The commonest affairs of life are changed as a result of the war. In change of conditions the gap that divides 1919 from 1914 is as great as the gap that divides the twentieth century from the eighteenth. The person who looks for a return of the conditions of 1914 in any readjustment of business or social affairs has been unable to read the signs of the times.

Those who have not awakened to the new order have been constantly reminded this summer by the National Prosperity League of some of the startling things five short years have witnessed.

Machines loaded with men and cargoes fly through the air for long distances at a rate of one hundred miles an hour. Ships of war can travel under the seas at speeds that rival the fastest sailing vessels of a century ago. Men on the surface of the earth talk through wireless telephones to men flying a mile high in the air. A speaker in Washington addresses a great street throng in New York City and his every word is distinctly heard by telephonic amplifiers of sound.

Great tonnage of freight is moved by trucks over open roads for greater distances and at higher speeds than were achieved by our railroads a few decades ago. Giant ocean steamships are to be built to force their way through the water faster than the average railroad train or touring automobile travels. Ships that required years for construction are now built in a few months—one cargo carrier was built in less than thirty days. Time of production for all commodities has been cut repeatedly. Processes of manufacture have been revolutionized.

America has passed from a debtor nation, owing billions, to a creditor nation, lending billions. Thirty thousand security holders in America have expanded into thirty million.

What were regarded as impossibilities only sixty months ago are now commonplace realties. Financially, commercially, socially, the world has been turned upside down. Preconceived notions and prejudices have gone into the discard. Things that would have been first page news sensations in the newspapers five years ago are now dismissed with a paragraph.

We are truly living in a new world, and in the main a much better world, thanks to the sacrifices of those who laid down their lives for freedom and justice in international intercourse. The past and its conditions have gone, never to return. We are living in a new era and it is time we all realized it.

Prices for everything we buy are higher and so are incomes and earnings. America never earned so much before and never had so much in its stocking. The best evidence is that the excess of exports over imports for the fiscal year of 1919 was $4,129,000,000 as against less than $500,000 in 1914.

The moral is, that if we have something to sell, let us go ahead and sell it; if we need something, let us go ahead and purchase it. We shall not be able to buy or sell at price levels of half a decade ago. We must stop conjecturing about the new order, and must accustom ourselves to the present and go ahead and do business.

Therefore, once more, let's go!

AIR ENTANGLEMENTS IN MINE VENTILATION

THE SUGGESTIVE editorial, which we here reproduce from *Coal Age*, originally appeared under the title: "A Bottle with Two Necks," which did not seem to us very satisfacory. We confess, however, that the title which we use here does not suit us much better.

At no part of the mine does the air travel so ast as in the mine entrance and the main return, whether that entrance or return be a drift mouth, lope or shaft. It is these two points, therefore, hat quite largely influence the resistance of the mine to the ventilating current. Further underground the air is split into multitude of more lowly moving currents, and the friction is accordngly reduced.

The amount of air to be delivered is not allowed in many cases to determine, as it should, the ize of the intake and return. This is largely ixed by a consideration of the use of these pasages for transit. We seem to imagine that the ir will force its way through these orifices if nly a fair way is provided beyond.

In the passageways leading to the fan especially, here are often sharp angles. Where the flows rom well separated districts return into a common current no attempt is made to prevent a conflict at the mouth of the single and narrow airway which, vastly too small for the service, must carry the air to the fan.

We overlook the fact that the air is provided with such narrow quarters it must be traveling fast and should be guided gently to its destination by well-shaped airways. We can give the air all kinds of harrowing experiences where the speed of travel is relatively slow, but where the air is moving rapidly the stream lines should be straight and undisturbed.

Unfortunately as we approach the surface the roof gets bad, and the exigencies of continued maintenance demand a more carefully protected roadway. Hence we tend to make the roadways narrow and fortify them with timber. The air eddies around in these narrow passages, and the friction is much greater than it would be in passages of the same size and carrying the same current if only the eddying were eliminated. Concreting such roadways by forms or with the cement gun is therefore a good means of increasing the ventilating capacity of the airway and hence of the whole mine; and it serves to prevent the airway, not to speak of the roadway, being blocked by ice in the winter.

It is perhaps unfortunate that we cannot see the air and so realize visually what a waste of energy there is when a ventilating current is churned up by a line of timber-set riffles. But what we do not see and know may hurt us most severely, and it is necessary for us to realize that we will not get efficient ventilation if we trip our air as it enters the mine by a lot of crossbars, legs and laggings and trap it as it leaves the workings by a series of similar resistances. A concreted shaft is not only safe and durable, it is a money saver in ventilation. No piping or cabling which goes lengthwise of the tunnel or shaft resists the air like the transverse timbering by which these airways are quite usually kept open.

In a recent issue we presented a sketch of Mr. Bruno V. Nordberg, for the facts contained in which we were indebted to our contemporary, *Power Plant Engineering*, a courteous recognition of which obligation we inadvertently neglected to make apparent at the time.

Our attention having been directed to the matter, we very glady make amends, and acknowledge with full credit the source of information which thousands of COMPRESSED AIR MAGAZINE readers found of interest. Mr. NORDBERG's career in the field of compressed air has been a long and honorable one, as this publication has frequently had occasion to note, and we would be delinquent in a sense of appreciation if we revealed ourselves as insensible to an understanding by other publications of what his influence has been in his years of usefulness.

LIQUID AIR FOR PERPETUAL MOTION—SURE, IT'S EASY

IT WAS, as we remember it, the *Scientific American* that once assured its readers that if ever a pseudo-inventor come along with an utterly impracticable mechanical invention it was sure to have a toggle-joint among its various contraptions. According to our observation and experience liquid air is now taking the place of the toggle-joint, and it is made to promise to do still greater wonders.

We print herewith a bit of very readable narrative from *The Gas Engine* showing how one inventor was proposing to exploit liquid air. It is impossible to read it without some lingering traces of incredulity! For instance, we have many doubts—which means that we have none at all—about liquid air having been made with a bicycle pump!

The Government Engineer sat at his desk carefully checking a column of figures. The intensity of his concentration cut him off from his surroundings as completely as if he were enclosed in armor plate. "All that stuff will be junk six months from now," spoke a voice at his elbow.

The engineer came back to earth with a snap. "Were you speaking to me?" he asked, as he pushed his spectacles up on his forehead and turned to the speaker.

"That's gasoline in those bottles there, isn't it?" the voice replied.

"Yes, gasoline and samples of other hydrocarbons," the other replied.

"That's all going to be junk in six months."

"Indeed?" and the scientist raised his eyebrows to accentuate the interrogation.

"Just so soon as I get my invention in working order," the visitor put forth.

"Rather hard on the oil companies," the engineer suggested, repressing a smile.

"I should worry about the oil companies. You see all I need to do is to get a little liquid air and use this to run an engine, and the engine turns the liquid into the tank and I use it over again. All I need for a starter is just a bicycle pump. I can make enough liquid air by hand with a bicycle pump to start the engine going. Then all I need is just the engine. Just think how fine it is. You can run your automobile with my liquid air engine until you are ready to stop, and you won't need any gasoline at all. And think of the motor boats and the ships and the airplanes. Don't you see that an airplane can fly around the world if it wants to without coming down, for it won't have to carry any gasoline and the engine will keep right on running until you stop it."

"You're not an engineer?" the other asked.

"No, I'm a lawyer, but some of the greatest inventions were made by men without being scientists and I actually have made liquid air with a common bicycle pump."

"Almost perpetual motion isn't it?" suggested the man at the desk.

"Not exactly, but the next thing to it. But the energy comes from the liquid air and not from nothing," the lawyer exclaimed.

"Fine business," agreed the engineer. "What becomes of the energy used to drive your automobile or your airplane.

"Oh, that goes right back into the liquid air, and its done automatically too. You see my scheme is to attach a pump to the engine and this pumps the liquid air right back into the tank."

"Quite a scheme," the man at the desk agreed.

"Yes," was the enthusiastic rejoinder "and just think of it, the Standard Oil Company and all its competitors will have to make something else besides gasoline or else go out of business when I get my engines going. It won't be long now. I have the capital all ready and all I need is the approval of the Government. That's what I am here for today."

"Did you ever hear of the principle known as the 'conservation of energy?'"

"No, not exactly."

"Do you know that it is proved beyond a shadow of a doubt that there is just so much energy in the universe and that you cannot increase or decrease it?"

"But what's that got to do with my scheme?"

"Your plan involves the increase of the total of energy."

"No sir, not at all. I get my energy out of the air where it is free to everybody and I don't increase it at all."

"What becomes of the energy you use to drive the engine and the engine gives out to drive the automobile?"

"Oh, I get that back out of the air by the pump on the engine."

"Well my friend you certainly have some scheme."

"You approve of it then?"

"No, not altogether, but I think it might be worth your while to try it out. It certainly would be an education for you in the principles underlying science."

"Don't you think I will get the Government to back it up?"

"The government is very peculiar in its attitude towards new inventions. The war is over and Uncle Sam is like the gentleman from Missouri, just now."

"Oh, I'll show them alright, just watch me. Here is my card. In six months the name on that card will be known throughout all the land as a benefactor to mankind."

"Will you premit me to make a suggestion?" the engineer asked the artist in liquid air.

"Certainly."

"Before you spend any money on this, read a book on elementary physics, then another on the principles of engines including chiefly those operated by compressed air and you will save yourself a lot of time and money you would otherwise spend in experimentation."

"Thanks, I'll do that. May I ask your name."

"My name is of no consequence," the other explained, "I am simply one of the cogs in the Government machine. However, I read the papers and if anything comes up I will certainly hear of it."

"You will, and before long too, good bye."

"Goodbye and the best of luck," and the visitor was gone.

As the door closed the engineer picked up his card. It bore the inscription Nelson Ulrich Thompson.

"N-U-T, Nut. My friend you were rightly named," the man at the desk remarked as he picked up his slide rule and resumed his computations.

MOTION PICTURES AS A MEANS OF FOREIGN ADVERTISING

AMERICAN manufacturers whose lines are sold widely in foreign markets have of late years been turning their attention to the moving picture as a possible means of developing larger sales and of stimulating a general sense of appreciation in overseas countries of American industrial products. Thus far too little has actually been accomplished. A score or more of large United States corporations have utilized the cinema for publicity purposes, but mainly at home. Four corporations that come quickly to mind in this connection are the Ford Motor Company, the General Electric Company, the Ingersoll-Rand Company, and the Niles-Bement-Pond Company. These concerns have spent many thousands of dollars on moving picture adjuncts to broad-gauge advertising.

One of the best known American producers in the moving picture field, D. W. GRIFFITH, who has done some really artistic things and who is regarded as an authority on the possibilities of the screen, is firmly of the belief that the motion picture will "Americanize the world." Its influence, at any rate he declares, is gradually spreading, and this unconscious and subconscious propaganda is exciting the admiration of other nations.

Mr. GRIFFITH classes the cinema as an art, and "the only truly American art that is seen and understood by every race on earth." The word "art" is so catholic a term, that it will get us nowhere, in considering the advantages to be derived from the commercial and educational application of the moving picture, to argue with Mr. GRIFFITH regarding the accuracy of his "art" characterization. We may safely grant, in passing, that some cinema productions are actually artistic—others, heaven and earth both proclaim, are deplorably lacking in art qualities.

The American field of industry may profitably consider, however, Mr. GRIFFITH'S expressions on the publicity side of the subject. He assures us that even the half civilized tribes in South Africa are now attending American picture shows. He has reports indicating that one picture is being exhibited simultaneously in Tokio, Rome, Paris, London and in South Africa, while being exhibited in the United States.

He regards, with deep conviction, the motion picture as the most comprehensive and most powerful force for propaganda work that the American nation possesses, because of the popular estimate of screen productions in other lands. In foreign countries the cinema picture is considered an art production, on a par (as an influence) with their plays, their paintings, their music and literature. Foreigners endeavor to understand and appreciate the motion picture as they do "other forms of art." It is being used, although without any art aim, in depicting American ideals before the world.

We feel like interjecting into Mr. GRIFFITH'S discussion of the subject a suggestion to the effect that the United States Government should exercise some sort of censorship over films that are exported, judging by the effects upon Americans, at least, of some of the scores of films which we have seen displayed in foreign countries. Only fear of international complications at times has restrained intelligent and patriotic Americans abroad from breaking up cinema exhibitions where anything but American *ideals* were depicted, and which gave the foreigner an entirely erroneous idea of American life.

There is truth, of course, in the main in Mr. GRIFFITH'S statement that abroad they see the American man on the screen as a graceful athlete, a great financier, or as some kind of genius. Always in heroic pose! It is the same with

American womanhood. She is represented as the highest type on earth in these pictures that go round the world.

Naturally the average scene is made in America. Our costumes or methods of business and our mode of living are presented all over the world every day. England and France, realizing this, have taken steps through their respective governments to acquire motion picture plants modelled on the American style. They have employed American directors and actors to turn out domestic films about those countries. This was done of course to offset the American influence on foreign trade.

Even German agents have been negotiating through agents here ever since the armistice was signed for the larger and better known American pictures with a view to showing them in Berlin. The audiences, tired of war, now want to devote spare time to other things, and the German theatrical men have been willing to pay any price within reason, cash down, for any length of contract, if they could have the pictures in Berlin. Such offers were rejected, according to Mr. GRIFFITH.

Our motion pictures figured in every Government department during the war. In fact they were the most satisfactory source of information concerning conditions on the battlefield —actual conditions, that is.

The film is being used at present in business, but it should develop into a larger field and with a far greater range of activity. Our big business men cannot afford to ignore the signs of the times, the great commercial struggle impending. If they do what Mr. GRIFFITH thinks they intend to do, they will take the American motion picture right into both their old and new territories and stimulate an interest in America and all things American.

"It's a strange fact but true," the picture impesario observes, "that in this country we are specialists, and we confine ourselves to our particular field. In Europe things are different. There an intelligent person familiarizes himself with the art of his time.

"Where in our country will you find business men or politicians preferring to dine with artists, writers or actors rather than with their own kind? It isn't done, that's all, except in rare instances such as dinners and other gatherings of a more or less public nature.

"The great empire builders of England, men like Winston Churchill, for example, are as good judges of acting as any dramatic critic in America. Why? Because they have studied it. Churchill studied scenario writing, not because he intended to write scenarios, but he wished to understand the motion picture. And Churchill, as can all of his colleagues, converses familiarly on almost any topic, the subject depending on the inclination of the other person. Churchill knows that the motion picture is the most effective propaganda for empire building today.

"Our books are not widely read in the world. Our music is not heard far from the seat of the English and American tongues. Our paintings are hung in our own galleries and studios. The reason for the supremacy of the cinema is its medium. It requires only one sense—sight. We all possess the same sight. We can interpret almost all of that which we can see. We believe at least half of it. It matters not to the African native or the Hindu, the French peasant or the Lithuanian, that he knows only his own language. He can read the pictures, and he is thinking American while thinking of what he has witnessed."

There is a deal of sound sense and truth in these views. The American manufacturer of machinery; particularly of that kind of machinery that is strikingly interesting in action, will be overlooking a great opportunity if he neglects the moving picture as a foreign advertising medium. There is a limit to what writers, illustrators and scientists can accomplish with their workaday tools and mediums in converting the world to a point of view. The moving picture affords a powerful support for their efforts in industrial, social and financial penetration.

Nearer approaches to mechanical perfections in the industries are bound to have sociological effects. Good machinery makes for high production and high wages, which are means to peace and contentment for capital and labor.

There are hopes ahead of thus far unguessed mechanical wonders that will help to stabilize the world. We need not give way to pessimism nor become infected with the black glooms of nations less favored. The world may have hopes of America, for we have hopes of ourselves.

Out of the free air may some day be snatched power elements now unharnessed. We may hope for a good deal yet from the internal combustion engine, and who knows, it may some fine day take the place of the steam engine, though that possibility now appears far off. A new fuel may come along, such as the "alcogas" by which the Navy is reported to have produced ten per cent. more power than with gasoline.

The New York Times published a cable dispatch not long since telling of the invention of the Still engine, which runs by gas explosions on one side the piston and by steam power produced by the explosions on the other side the piston, with a gain over the Diesel engine of ten per cent. or more in power and economy in fuel of half. Such an engine might prove too heavy for aviation work, and yet nobody can foretell the weight limit of air machines.

Between 1908 and 1913 sixty per cent. of air casualties were due to mechanical collapses, but since then only two per cent., and the air machine is still a baby.

It seems a poor substitute for the locomotive, and yet who foresaw the locomotive's possibilities or its limitations? The rail made the locomotive an all-year worker, and gave the railway a permanent precedence over either the canal or the dirt roads.

The air-filled tire divorces the automobile from the rail and gives it a universal use which the locomotive can never have. The air machine is as free as the bird, and nobody can say where it may not go in another century.

It has been most interesting to note the editorial expressions called forth by Mr. VANDERLIP's words of warning, and encouraging that they bring a reaction of optimism. As *The Times* remarked, "there is no more reason why pessimism should monopolize all the attention than why the devil should have all the good tunes."

There is even better reason for fancying that pessimism has exhausted invention than that optimism has.

There is a very great capacity in what will follow labor's impending discovery that capitalism supplies tools which men merely assist, driving the tool and saving the energy expended when the total was driven by human muscle. This is what explains our world, the existence of factories, the maintenance of social life in cities, while machines produce food in abundance beyond the power of the man with the hoe.

Just as the spinning mule displaced the distaff in the eighteenth century and the steamship the sailing vessel in the nineteenth, so in the twentieth there will be more gains in efficiency. Anyway, the world has hopes of something, and as long as there is hope there are life and growth and better days ahead.

THE ROOSEVELT MEMORIAL ASSOCIATION

THE ROOSEVELT Memorial Association has been formed to provide memorials in accordance with the plans of the National Committee, which will include the erection of a suitable and adequate monumental memorial in Washington; and acquiring, development and maintenance of a park in the town of Oyster Bay which may ultimately, perhaps, include Sagamore Hill, to be preserved like Mount Vernon and Mr LINCOLN's home at Springfield, Ills.

In order to carry this program to success, the Association will need a minimum of $10,000,000 and so that participation in the creation of this memorial fund may be general, it asks for subscriptions thereto from millions of individuals.

Unselfish and sincere in purpose, unswerving in seeking the right and following it, definite and direct in action, with his theory of personal responsibility for wrong-doing and his creed of "the square deal" for all, Col. ROOSEVELT gave a lifetime of devoted public service which must stand as an inspiration to the youth of this land for all time. Ardently American, believing profoundly that only through fullest acceptance of America's privileges and responsibilities could the people of this country realize their highest well-being and fulfill their obligations to themselves and to humanity, he set up ideals which citizens of all lands have found not only a duty but a privilege to follow.

His legion admirers feel that a memorial to ROOSEVELT will not so much honor him as honor America and the citizens who raise it to him. A contribution to the ROOSEVELT Memorial will be, in the highest sense, a pledge of devotion to ideal citizenship. Checks may be sent to ALBERT H. WIGGIN, Treasurer, Roosevelt Memorial Association, 1 Madison Avenue, New York City.

SUGGESTION OF A FRIEND FOR A QUESTION BOX

To The Editors of COMPRESSED AIR MAGAZINE:—The writer has received your interesting monthly publication for many years. The magazine covers timely topics in its field and is always replete with interesting facts. Now that you are expanding so energetically and bringing up such discussions as compressed air courses in schools of technology and universities, permit me to make a suggestion that I am confident is a meritorious one.

The compressed air field of today is a large one and each succeeding year finds many new additions in our enormous industrial field. From past experiences I gather that technical knowledge is required solely in the proper selection of the air compressor. The compressor alone would be of no use if there were not air-operated labor-saving devices to operate. Thus, these vital accessories are the stability of the compressor field. I refer, of course, to pneumatic tools, rock and subaqueous drills, sharpeners, air-lifts and kindred tools, used the world over.

The manufacturer has got to be up early and doing incessantly to keep pace with his brother manufacturer, which brings us to the issue of competition. I will state from experience that these air-operated accessories are in most instances selected and purchased by men who are not interested in the technical points of superiority, but solely in the ability of the tool to save time and money and show savings over hand work or over tools offered by other makers. If it is all that is claimed for it, it sticks on the job, repeat orders follow and the manufacturer is rewarded with large business.

Furthermore, your magazine is appreciated most by the superintendent who is constantly looking for the latest in compressed air tools and other equipment. He and his subordinates have many hard problems to solve. Sometimes a riveter, rock drill or an air lift is condemned because the operator is confronted with a problem he cannot solve.

This brings us to the suggestion I have in mind, and that is, that you allot a certain space each month to a "Questions and Answers Department." I believe this would help many a superintendent and engineer that is condemning a good piece of compressed air equipment. I have been of this opinion for a long time and believe that your inauguration of such a department would meet with an appreciative response.

In common with other readers and well-wishers of COMPRESSED AIR MAGAZINE, I hope that you will give this matter serious and favorable consideration.

E. F. BOYLE.

San Antonio, Texas,
Postoffice Box 893,
July 26, 1919.

We have had in view for some time the reestablishment of such a department, which was formerly conducted in these columns, and we are appreciative of Mr. Boyle's suggestion. The object of COMPRESSED AIR MAGAZINE is to disseminate useful information. It sincerely desires to be of real assistance to its readers. We have decided to act at once, therefore, on the suggestion of our correspondent, and are glad to announce that we shall be pleased to answer to the best of our ability all questions forwarded to us, provided they are put clearly and explicitly and that all of the circumstances surrounding a given case are given as a working basis for an intelligent reply. Both question and answer will be published for the benefit of all readers, some of whom may have parallel problems. We cannot undertake to make private replies by mail.—THE EDITORS.

The article by Frank Richards, "The Air Receiver," published in COMPRESSED AIR MAGAZINE for August, appeared originally, and practically simultaneously, in *The Engineer,* London, and *Power Plant Engineering,* Chicago, of which fact we omitted to make a publication note at the time. The article attracted widespread attention among compressed air engineers both here and abroad.

Personal Intelligence

Samuel Thomas Wellman, inventor, manufacturer and engineer of Cleveland, Ohio, is dead at seventy-two after a half century of identification with the improvement of equipment used in the making of steel. He introduced the electric charging machine and the handling of materials by the electric magnet, which devices are now in widespread use throughout the world. His genius lowered the price of steel, shortened labor in its manfacture and saved millions of dollars to the industrial world. He was an expert who was constantly eager to learn more about steel making. About two years ago he is said to have remarked: "It is fifty years since I left my home in the hills of New Hampshire and started for Pittsburgh to get my first insight into the steel business. I have been trying to learn all about it ever since, but what I don't know would still fill a big book." He was a member of many engineering and scientific societies. He left two daughters and three sons.

At the commencement of the University of Pittsburgh, the honorary degree of Doctor of Engineering was conferred upon Vannoy H. Manning, of Washington, D. C., the Director of the Bureau of Mines, Department of the Interior. Dr. Raymond F. Bacon, Director of the Mellon Institute, said in his presentation address: "This distinction is most appropriately conferred upon Mr. Manning in recognition of his leadership of all work on the conservation of our natural resources. Possessing the highest executive ability, an authority on mineral technology, Mr. Manning has rendered inestimably valuable service to the nation in the development of the activities of our world-famed Bureau of Mines and in demonstrating to our industrialists and legislators that research is the basis of national development."

* * * *

We regret to record the death of Frederick Sargeant, senior partner in the engineering firm of Sargent & Lundy, Chicago, who passed away on July 26 at his home in Glencoe, Ills., as the result of an illness which began while he was in England last spring. He was born in England in 1859. He obtained his early mechanical and engineering training in Scotland and set forth for the United States in 1880. After varied experiences in the Middle West he became consulting engineer of the Chicago Edison Co. in 1887 and remained in that capacity for the company and its successors, the Commonwealth Edison Co. to the time of his demise. Lack of space prevents our detailing his many achievements. He was known for his notable work as consulting electrical engineer for the World's Columbian Exposition at Chicago, by which he was honored with a medal. His work was by no means confined to Chicago, for he was consultant for scores of power and light corporations throughout the country, designing machinery layouts for many plants. He was a member of many clubs and left a widow, a daughter and two sons.

* * * *

The Chicago Pneumatic Tool Company has appointed L. C. Sprague, formerly district manager of sales at New York as manager of western railroad sales with headquarters in the Fisher building, Chicago, and H. G. Barbee as manager of eastern railroad sales with headquarters at 52 Vanderbilt Ave., New York City. Nelson B. Gatch, formerly district manager of sales at Chicago, has been appointed district manager of sales at New York, succeeding Mr. Sprague. The company also has appointed R. S. Thulin as special railroad representative on the staff of Mr. Sprague. The company's Minneapolis office has been moved from the Metropolitan Bank Building to Fifth Avenue and Fifth Street South. J. L. Canby has been made district manager of sales at Chicago.

* * * *

Major Hugo Diemer, lately of the Ordnance Department, U. S. A., has become superintendent of personnel for the Winchester Arms and Manufacturing Co., New Haven, Conn., resigning his chair of industrial engineering at the Pennsylvania State College.

* * * *

Their nominations having been confirmed by the Senate, Judge John Barton Payne, Henry M. Robinson, and Commander Thomas A. Scott, whom the President had nominated as Commissioners of the United States Shipping Board, assumed office August 14 and attended the regular meeting of the Board. The Board now has a full membership, consisting of Judge Payne, elected chairman; Raymond B. Stevens, vice chairman; and Commissioners John A. Donald, Henry M. Robinson, and Thomas A. Scott.

* * * *

William P. Donovan, general superintendent of the Gasolene Department of the Gpysy Oil Company, Tulsa, Okla., is dead at the age of 44 in Philadelphia. He was born in Eagle Rock, Pa.,where he was educated in the local schools. He entered the oil business in 1892 with the Crescent Pipe Line Co. and assisted in the construction of a pipe line from Oakdale to Marcus Hook, Pa. In 1902 Mr. Donovan became superintendent of distribution of the Gulf Refining Co. at Bayonne, N. J. He went with an affiliated concern, the Gypsy, in 1913, and he designed and constructed plants in Louisiana, Oklahoma, Texas and Mexico for the production of gasoline from casinghead gas.

* * * *

Morris Knowles has returned to Pittsburgh, having ended his engagement as chief engineer of the housing department of the Emergency Fleet Corporation.

* * * *

H. H. Esselstyn, Commissioner of Public works of the City of Detroit, resigned to resume his activities with the firm of Esselstyn, Murphy & Hanford of that city, architects and engineers, his giving up public duties having been the result of the extended business of the company.

* * * *

George B. Allen, Texas representative of the Yarnall-Waring Company, Philadelphia, who has been located at 305 Southern Pacific Building, Houston, will hereafter make his headquarters in Dallas, for the sale of their well known *Yarway* Fuel Saving Specialties.

CONFIDENTIAL EMPLOYMENT BUREAU

NOTE—Advertisements under either of the classifications below will be numbered in the order of receipt and published free of charge, for the benefit of readers, in the next issue after date. All applications for the use of this convenience should be directed, "Confidential Employment Bureau," Compressed Air Magazine, Bowling Green Building, New York City. Replies to advertisements will be forwarded to the person or persons concerned.

POSITIONS WANTED.

No. 850—Mining engineer, nine years' experience iron open pit and underground, two degrees, Mich. College Mines, copper experience British Columbia and Washington, now foreman large open pit, seeks place as superintendent or assistant. Wants minimum $5,000. Services available this Autumn.

No. 851—Place wanted as expert Leyner Drill Sharpener operator. Long experience in Minnesota iron country and Michigan Copper Range. Steady workman, well recommended. Prefers Colorado.

No. 852—Drill repair man seeks change. If you want a good "doctor" this man declares he can fill requirements. Age 32. Married. Will go anywhere.

No. 853—Mining engineer, Mich., Col. Mines, eight years with Copper Queen, C. & H., etc., wants place on selling force or in advertising for mining machinery house. Salary $250 to start.

HELP WANTED.

No. 426—Experienced miners wanted for Northern Peninsula of Michigan on the Copper Range. Large company and one of best known. Steady, permanent employment for good men under favorable conditions. Write at once to this bureau, giving experience.

No. 427—Young civil engineer wanted by a large contractor in connection with a special engineering job to last about one year. Future connection depends on man. Give experience, references and salary expected. Applications received in strictest confidence.

No. 428—Middle West manufacturer with progressive line and expanding business wishes an able production manager, who must have ginger and ability to handle workmen successfully. Personality will count more than knowledge of manufacturer's line. Write giving full details about history, experience in manufacturing, engineering experience, if any, and what salary would be required.

NOTE—Positions No. 422, August issue, and No. 418, July issue, still unfilled.

Buenos Aires

WIT THAT SPARKLES

True wit is like the brilliant stone,
  Dug from East Indian mine,
Which boasts two various powers in one,
  To cut as well as shine.
Genius, like that, if polished right,
  With the same gifts abounds,
Appears at once both keen and bright,
  And sparkles while it wounds!

Our idea of the height of camouflage, if not of naivete, is a Rolls-Royce radiator and Packard hub cabs on a Henry-Ford, which Nth power exhibit of concealed identification we saw with our very own eyes in Riverside Drive, New York, in front of the Soldiers and Sailors Monument a few days ago.

A southern newspaper comments unkindly to the effect that a New York restaurant has advertised it will open at the historic home of the famous Captain Kidd, in order to carry on business at the old stand.

IT CANNOT BE DONE

"Poets," says Horace, "who expect
  Their verses should for ever live,
Nine years each poem must neglect
  Ere they the final polish give."
This rule might suit the Roman bard;
  But Greenwich Village poets smile
To think, if they their sales retard
  Nine years—how they must live the while!

Uniform Minus Vermiform

Our attention is directed by Bunny, sometime major of engineers in the A. E. F., and a spoofer and bit of wag in his way, to a War Department volume on his desk, which is entitled, "Report by chief of engineers without appendices."

The Usual Way

From the Detroit Free Press.

He worked by day
  And toiled by night,
He gave up play
  And all delight.
Dry books he read
  New things to learn
And forged ahead
  Success to earn.
He plodded on
  With faith and pluck,
And when he won
  Men called it luck.

The Cornish miners, or Cousin Jacks, of the iron and copper countries do everything with dynamite. "Mick" Kelley of Marble, Minn., superintendent of an open pit mine, told us that one Cornishman had a cat, the nine lives of which it was desirable to snuff out, in his estimation. He took the cat outdoors and tied a stick of dynamite to its back, with lighted fuse attached. The cat promptly made nimble tracks for the kitchen and crawled under the stove. The miner reached the kitchen just as it was mounting heavenward and a fragment of stove in passing clipped one of his ears off neatly. When the Cousin Jack is asked how he lost the ear, he replies, "A cat did it."

BAWMIE INTHEBEAN.

AIR MACHINERY EXPORTS

The Bureau of Foreign and Domestic Commerce, Department of Commerce, announces through its statistical division the following exports of air-compressing machinery from the United States to all foreign countries for the month of May, 1919:

Countries	*Dollars*
Belgium	13,376
France	262,514
Spain	3,100
England	333
Canada	11,909
Nicaragua	3,075
Mexico	7,795
Newfoundland and Labrador	79
Cuba	19,054
Haiti	126
Dominican Republic	90
Brazil	21,052
Chile	17,123
Peru	13,585
Uruguay	342
Venezuela	162
China	6,157
British India	12,284
Dutch East Indies	118
Japan	41,766
Australia	1,336
New Zealand	1,940
Philippine Islands	9,274
British South Africa	3,707
French Africa	4,700
Total	$454,997

Books and Writers

LABOR AND RECONSTRUCTION IN EUROPE, by Elisha M. Friedman. Price, $2.50 net. New York: Messrs. E. P. Dutton & Co.

MR. FRIEDMAN, who was formerly the statistician for Messrs. Eugene Meyer & Co., of New York, and who was the editor of "American Problems of Reconstruction," has evolved a highly interesting and valuable book on the reconstruction conditions and problems of the various European countries. The labor problem is admittedly the gravest of the social and economic problems that have come to a climax following the restoration of peace between nations, if that point can be said to have arrived actually. America must have an accurate knowledge of the methods which have been developed in European countries to deal with the problems of labor and of the significance of the labor currents in those countries.

Mr. Friedman's new work is the first attempt to supply that knowledge to American readers. It lays before us the necessary facts concerning the reconstruction commissions which have been formed in practically every country of Europe, neutral as well as belligerent; it sums up the chief problems confronting these commissions and it gives in very full detail the different aspects of the labor problem as it particularly confronts Great Britain and Germany.

The author shows both good taste and discretion in that he advocates no policy and sponsors no scheme. His sole care has been to present the facts, like a good reporter, and whenever possible, quotations are given from the documents published in the different countries, so as to preserve the original point of view.

The book contains an introduction by Mr. William B. Wilson, Secretary of Labor, who observes that the great value of Mr. Friedman's effort is that it brings together, in consecutive order, a vast amount of useful information at an opportune time, when those who most desire to avail themselves of it would be too busy to assemble it themselves. There is, too, another value, as Mr. Wilson says, and perhaps the greatest of all, in such a book, put forth at a time of storm and stress in the world. "It induces deliberative thought, and this has always been the most potent factor of right reason in the progress of mankind."

The Bureau of Standards, Department of Commerce, Washington, D. C., has issued circular No. 76, setting forth the physical properties of aluminum and its light alloys. The details of the manufacture operations are described, with particulars in regard to temperatures, weights, resistance and other properties. Copies may be had free on application.

The Bureau of Mines, Washington, D. C., has issued a 14-page bulletin presenting the results of its investigations concerning the use of TNT as a blasting explosive. The bulletin, prepared by Charles E. Monroe and Spencer P. Howell, shows how TNT may be safely and efficiently used in industrial blasting operations by those skilled in blasting and corrects many erroneous or misleading statements which have been circulated as to the properties of TNT by giving the results of careful experiments made at the Bureau of Mines Experiment Station.

NELSON'S PERPETUAL LOOSE-LEAF ENCYCLOPAEDIA, An International Work of Reference. Complete in 12 volumes, with 7,000 illustrations, colored plates, colored maps and engravings. John H. Finley, LL.D., editor-in-chief, Commissioner of Education and President of the University of the State of New York. New York: Thomas Nelson & Sons.

WE HAVE received from the publishers some interesting specimen pages showing recent additions to Nelson's Loose-Leaf Encyclopaedia, which are illustrative of how this standard reference work is kept constantly up to date. As Dr. Schurman of Cornell says, ordinary encyclopaedias speedily become obsolete. Works that are revised once in a decade are often twenty and thirty years behind the times on certain subjects, as we have had occasion to note with vexation in the case of one celebrated work we bought last year for personal use at a cost of more than one hundred dollars.

The publishers of Nelson's assert for it that it is virtually made anew every six months, but that in reality the process of keeping the loose-leaf encyclopaedia up to date is practically continuous. In March and October of each year subscribers receive 250 or more new or revised pages. Some 3,000 or more changes are made a year to keep pace with the never-halting progress of the world's development. The accuracy and dependability of the work is therefore obvious.

We note that this encyclopaedia keeps particularly well abreast of the times on American industrial and scientific subjects and for this reason, if for no other, are glad to commend it to our readers in the engineering profession and throughout the manufacturing industries.

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Penn., has issued a complete catalogue in which all of its electrical supplies are listed. The volume contains 1264 pages of descriptive matter pertaining to the products of the company, some twenty pages comprise a complete cross index and index to style numbers and a table of "Approximate Cost Multipliers." Although the book is a catalog it contains much information of a technical and engineering nature. It is planned to make its issue annually, and it is believed to be the first volume of this kind published by an electrical firm having such a wide diversified product as the Westinghouse Company.

The Babcock & Wilcox Company, New York City, is distributing a treatise written by Mr. Arthur D. Pratt, entitled "Principles of Combustion in the Steam Boiler Furnace." There are 112 pages 6 by 9 inches in size; the volume is indexed and cloth bound. The viewpoint from which it has been written is that the efficient generation of steam in the boiler proper becomes in reality a question of efficient combustion, for most types of apparatus used for steam or for power generation have reached a high state of development. Therefore, the matter in the book is aimed at this phase of boiler practice. The titles of the chapters or sections into which the book is divided are: The Chemistry of Combustion; Density Weight and Volume of Gases; Heat of Combustion; Specific Heat; Temperatures Developed in Combustion; Air and Combustion; Combustion Formulae; Combustion Losses; Smoke; General Conclusions; The Computation of Combustion Data; Heat Balance.

The Wheeler Condenser and Engineering Company, Carteret, N. J., has issued preliminary bulletin No. 113, illustrating and describing the Wheeler steam jet air pump. Its pages explain the operating principles, give reasons for the efficiency obtained, minutely describe the inter-condenser, and show a set of operating test curves. There is also included a cross-sectional drawing showing how to connect double or triple machines to condensers.

UP-TO-DATE AIR-BRAKE CATECHISM, by Robert H. Blackall. Revised, and illustrated by detail engravings and colored plates, including 2,500 questions with their answers. Price, $2.50 net. New York: The Norman W. Henley Publishing Co.

AIR-BRAKE practice has undergone many changes in the last decade, what with longer trains, cars of heavier capacity and locomotives of greater power and weight. In the revision of the Blackall book to bring it up to present conditions, the observation is made that the original air brake was designed with the idea in mind that maximum length of trains would be fifty cars, each of a capacity of 60,000 pounds. A large percentage of cars today have a capacity of 100,000 pounds, the number of cars in a train is often 100, and the hauling power of the locomotive has kept pace. Passenger cars and engines have also doubled in weight. The result of these changes has been that much apparatus in use for many years is not adequate to handle, with the desired efficiency, the long and heavy trains of today.

As a result of the heavier equipment and increased traffic, the Westinghouse Air Brake Company has developed new engine and car equipment by the use of which even better results are obtained with the long and heavy trains than could be obtained with the older equipment and shorter trains. Passenger trains are stopped in about the same distance as was accomplished with the older form of highspeed brake and the lighter equipment in general use during the previous ten years.

The Blackall "Catechism" comprises examination questions for engineers and firemen and all other railroad men preparing to pass an examination on the subject of air brakes. The book, in its various editions, has been endorsed for its practical value by air-brake instructors and examiners on nearly every railroad in this country. It is one of a series of the Henley practical railroad books that are well nigh biblical in their value to workers of the rail.

MODERN MACHINE SHOP CONSTRUCTION, EQUIPMENT AND MANAGEMENT, by Oscar E. Perrigo. Price, $5 net. New York: Norman W. Henley Publishing Co.

OUR FIRST viewing of this work has well repaid us and filled us with admiration for Mr. Perrigo's comprehensive survey of his subject. Administrative officers will find this book of peculiar value, as well as of ready interest. The title tells the ground covered by the author, who is a member of the American Society of Mechanical Engineers and a recognized expert in machine shop and factory organization, modern shop methods and time and cost systems.

The book is a comprehensive and practical treatise on economical building and the efficient equipment of shops and their successful management. Factories as well as machine shops are considered by the author, whose views may profitably be considered by architects and engineers as well as by the heads of manufacturing concerns and their various departments.

The author may well take pride in his having enjoyed over twenty years of successful management of shops and factories without having in a single instance encountered "labor troubles," on which many contemporaries will envy him. He believes that much of this smooth-running efficiency has been due to his thorough belief in the intelligent initiative and honest pride of the American mechanic in his work. He is right, for it isn't as a rule the American workman that stirs up the disastrous labor difficulties we have sometimes witnessed, but the imported agitator.

In another revision of this work we hope Mr. Perrigo will devote thought and space to compressed air equipment for machine shops, which would round out to completeness the book's utility.

F. J. T.

HOW TO FIND FACTORY COSTS, by C. Bertrand Thompson. Illustrated with fifty-one charts, seven diagrams and one table. Price, $2.15. A. W. Shaw Company, Chicago, New York, London.

ATTENTION is called in the preface of this work to the fact that less than 20% of business concerns have a cost system, to which deplorable condition is credited, and rightfully so, a large proportion of business failure.

How To Find Factory Costs is written for the manager, the executive and the accountant and is intended to have sufficient breadth to cover industries in general. Initially the book "sells" the reader the idea that a cost system is a necessity in his business and that furthermore a cost system cannot be too good on the same grounds that a business cannot be too profitable.

In successive steps and in quite some detail, aided by excellent charts and diagrams, are taken up the various sub-divisions of cost keeping and accounting and the influence of these important factors upon operations in general and in particular. Direct costs, indirect costs, allowance of interest and depreciation, methods of distribution, the machine-hour rate plan and other fundamentals including the cost of selling, are covered in a manner that should enable the seeker for information to solve some of his knotty problems and perhaps discover new problems to solve.

D. C. G.

PUBLICATIONS RECEIVED

A LECTURE ON ORGANIZATION (reprint) by J. Lee Nicholson of Columbia University. Issued by Messrs. J. Lee Nicholson & Co., accountants and industrial engineers, New York and Chicago. A useful pamphlet designed to assist in the advancement and betterment of American business interests and making for method and efficiency in management. Executives may obtain copies by addressing Messrs. Nicholson at either their New York or their Chicago offices, located respectively in the Woolworth building and the Harris Trust building.

A BUSINESS MAN'S EXPERIENCE WITH INDUSTRIAL TRAINING, by E. A. Barnes, General Electric Co., Fort Wayne, Ind. A message of great value for every manufacturer in America. Issued by the U. S. Department of Labor, U. S. Training Service, C. T. Clayton, Director, as Training Bulletin No. 10. Washington: Government Printing Office.

HOW TO FIND FACTORY COSTS, by C. Bertrand Thompson, Industrial Consultant. Illustrated with fifty-one charts, seven diagrams and one table. Price, $5. Chicago: A. W. Shaw Company. See Review.

LABOR AND RECONSTRUCTION IN EUROPE, by Elisha M. Friedman, Editor, American Problems of Reconstruction. With an introduction by Hon. William B. Wilson, Secretary of Labor. Price, $2.50 net. New York: E. P. Dutton & Company. See review.

TREATMENT OF INDUSTRIAL PROBLEMS BY CONSTRUCTIVE METHODS, issued by the U. S. Department of Labor, Working Conditions Service, Grant Hamilton, Director General. A booklet issued for the purpose of indicating to the business world that efforts to promote industrial health, safety and employment management do not constitute humanitarian idealism and are not merely the fads of the kind hearted, but represent hard-headed business acumen. The prevention of sickness, accidents and labor disturbances is recognized as good business. The fecilities of the Working Conditions Service are detailed for the benefit of industrial managers who desire to avail themselves of expert research. Sent free on application to the Department of Labor. Washington: Government Printing Office.

PRINCIPLES OF FOREIGN TRADE, by Norbert Savay, A. M., LL.B. An entirely new manuel, covering every aspect of foreign trade. Price, $4 net. New York: Ronald Press Co.

OUR FIRST AIRWAYS, THEIR ORGANIZATION, EQUIPMENT AND FINANCE, by Claude Grahame-White and Harry Harper, with eleven special illustrations by Mr. Geoffrey Watson. Price, $1.50 net. New York: John Lane Company.

THE A-B-C OF AVIATION, by Capt. Victor W. Page, Sig. R. C., A. S., member Society of Automotive Engineers and late chief engineer officer, Signal Corps Aviation School, Hazelhurst Field, Mineola, L. I. Illustrated with drawings and photographs. Price, $2.50 net. New York: The Norman W. Henley Publishing Company.

EFFICIENT RAILWAY OPERATION, by Henry S. Haines. An expert's book by an expert. Containing tables, valuable data and statistics. Price, $4 net. New York: The Macmillan Company.

LUMBER MANUFACTURING ACCOUNTS, by Arthur F. Jones. Second printing. Price, $2 net. New York: The Ronald Press Co.

MODERN MACHINE SHOP CONSTRUCTION, EQUIPMENT AND MANAGEMENT, by Oscar E. Perrigo. Second edition, revised and enlarged. Illustrated with 219 engravings especially made by the author. Price, $5 net. New York: Norman W. Henley Publishing Co. See Review.

WAR DEPARTMENT ANNUAL REPORTS, Vols. 1, 2 and 3. Vol. 1 contains annual reports of the Secretary of War, Chief of Staff, Adjutant General, Inspector General, Judge Advocate General, Quartermaster General, Surgeon General, Chief of Ordnance, Chief Signal Officer, Chief of the Militia Bureau, Chief of Coast Artillery, Chief of Construction Division, Director of Military Aeronautics, Director of Tank Corps, Director of Chemical War Service, Director of Aircraft Production, Superintendent of Military Academy, Chickamauga and Chattanooga Park Commission, Gettysburg Park Commission, Shiloh Park Commission and Vicksburg Park Commission; Vol. 2 contains the report of the Chief of Engineers (without appendices); Vol. 3 contains the reports of the Chief of the Bureau of Insular Affairs, 1918; the Governor of Porto Rico, 1918, and the Philippine Commission, 1917. Washington: Government Printing Office.

Latest U. S. Patents

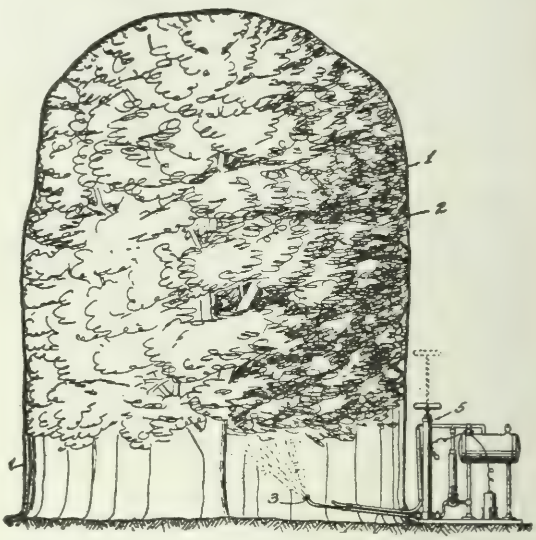
Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MAY 27.

1,304,589. HAIR-DRIER. George W. Moore, Chicago, Ill.

1,304,671. AIR-PROPELLER. Ernest D. Fieux, New York, N. Y., and Harry S. Wheller, Rahway, N. J.

1,304,747. METHOD OF FUMIGATING. William G. Dingle, Los Angeles, Calif.



PATENT NO. 1,304,747.

1,304,915. PNEUMATIC INSOLE. Burton A. Spinney, Des Moines, Iowa.

1,304,922. MOLDING APPARATUS. Henry Tscherning, Freeport, Ill.

1,304,973. FUEL-FEEDING DEVICE. Charles S. Heffelfinger, Lebanon, Pa.

1,305,040. PNEUMATIC PUMP. Marion C. Walls, Franklin township, Hendricks county, Ind.

1,305,065. SHOCK-ABSORBER. Samuel Goff Conkling, Brooklyn, N. Y.

1,305,086. SANDING DEVICE. Alva A. Fryer, Kansas City, Mo.

JUNE 3.

1,305,242. PNEUMATIC CLEANER. George W. Allen, Boston, Mass.

1,305,260-1-6. COMPRESSED-AIR VALVE AND GAGE. Lucien T. Earnheart, Indianapolis, Ind.

1,305,349. PERCUSSION ROCK-DRILL. James Fletcher, Newnes, New South Wales, Australia.

1,305,403. PNEUMATIC-DESPATCH-TUBE APPARATUS. Emmett B. Perrine, Minneapolis, Minn.

1,305,574. AIR-BLAST PLASTERING-MACHINE. Gilbert E. White, Kewanee, Ill.

1,305,599. PROCESS FOR DRYING VARIOUS SUBSTANCES. Auguste A. Goubert, Englewood, N. J.

1,305,726. FLUID-PRESSURE APPARATUS FOR BURNING POWDERED FUEL. Patrick A. Leonard, Michael F. Maloney, and Ernest Fandrich, Schenectady, N. Y.

1,305,733. BRUSH. Robert P. Miller and Charles J. Bremer, St. Louis, Mo.

1,305,758. AIR-PUMP. Robert Warnock, Bloomfield, N. J.

1. In an air pump, the combination of a cylinder, piston, connecting road crank and a crank case in which said crank operates, said crank case being closed at the bottom to provide a lubricant reservoir, the exhaust from said cylinder taking place into said crank case.

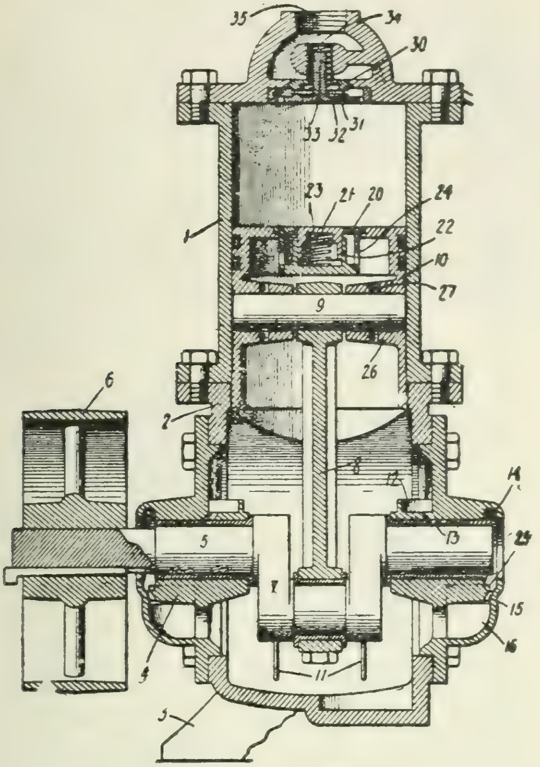
1,305,769. AIR-CIRCULATING DEVICE. Nicholas J. Cavagnaro, Union Course, N. Y.

1,305,789. WINDMILL. Clarence E. Flinchbaugh, Lima, Ohio.

1,305,912. AUTOMATIC SPRINKLER SYSTEM. Albert J. Loepsinger, Edgewood, R. I.

1,305,926. AIR-MOISTENER AND DUST-COLLECTOR. John S. Nelson, Sioux Falls, S. D.

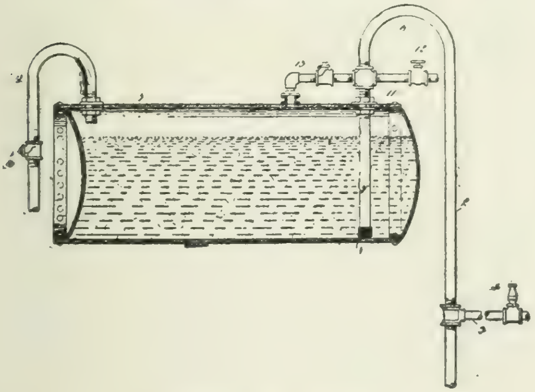
1,305,943-4-5. HUMIDIFIER. Raymond D. Smith, Arlington, Mass.



PATENT NO. 1,305,758.

JUNE 24.

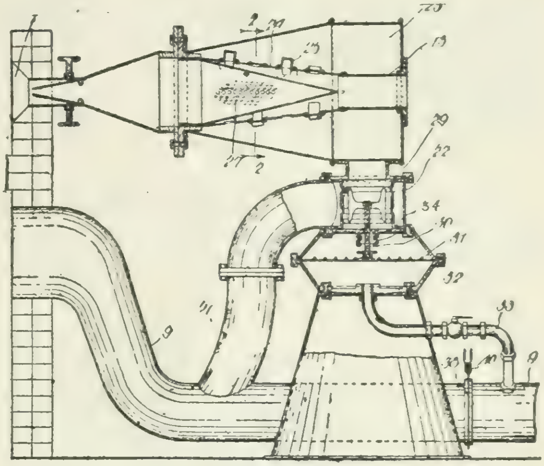
1,307,348. AUTOMATIC DOOR OPENER AND CLOSER. Peter L. De Marce, Minneapolis, Minn.
1,307,350. PNEUMATIC VALVE-ACTION. Stanley L. Fisher, Saybrook, Conn.
1,307,365. DEVICE FOR AERATING POWDERED FUEL. Alonzo G. Kinyon, Chicago, Ill.



PATENT NO. 1,305,912.

1,307,375. COMBUSTION OF POWDERED FUEL. Harry B. Pruden, Chicago, Ill.

A method of preparing powdered fuel for combustion which consists in maintaining a mass of powdered fuel in an inclosed space causing jets of air to impinge upon the fuel across an air space adjacent the fuel thus creating and maintaining a body of fuel-laden air in contact with said mass of powdered fuel, and agitating the fuel-laden air continuously to prevent precipitation of the fuel, and continuously drawing a supply of the mixture therefrom and feeding it to the place of combustion.

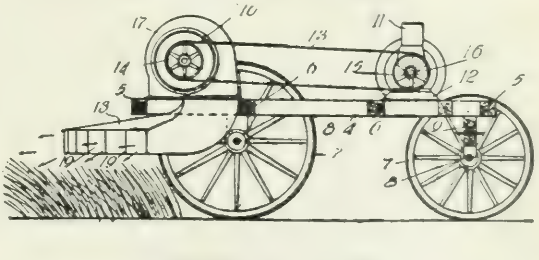


PATENT NO. 1,307,875.

1,307,459. MULTIPLE-BELLOWS PUMP. Lyman R. Roberts, Rutherford, N. J.
1,307,656. AIR-COOLING MACHINE. Santiago Camberos and David S. Camberos, Tuscon, Ariz.
1,307,875. METHOD OF EFFECTING HUMIDIFICATION. Lee H. Parker, Boston, Mass.
1,307,929. MILKING-MACHINE. Richard Northey Saunders, Auckland, New Zealand.
1,308,016. GAS-OPERATED GUN. William R. Clark, Seattle, Wash.

JUNE 10.

1,306,024. PNEUMATIC SEPARATOR. Frank H. Quade, Jr., Fresno, Calif.
1,306,075. MOLDING-MACHINE. Edgar H. Mumford, deceased, Plainfield, N. J., by Rose S. Mumford, executrix, Plainfield, N. J.
1,306,106. DRILL-STEEL-PINNING DEVICE. Jesse Ditson, Littleton, Colo.
1,306,159. PNEUMATIC MOTOR. Gustav W. Wallin, Chicago, Ill.
1,306,209. METHOD FOR ARTIFICIALLY COMPELLING THE FECUNDATION OF ALFALFA. William M. Williams, Harlem, Mont.



PATENT NO. 1,306,209.

The herein described method for effecting the fecundation of alfalfa, consisting in subjecting the stamen inclosing pods as soon as they have arrived at maturity to an artificially produced uniform current of air directed against the pods with sufficient force to drive the pods to bursting impact against members of the plant and to release and uniformly distribute the pollen.

1,306,300. PNEUMATIC IMPACT-TOOL. William Burlingham, Newport News, Va.
1,306,301. FLUID-MOTOR. John William Chadwick, Kansas City, Mo.
1,306,372. SUBMARINE MINE. Charles E. Egan and Elva F. Jackson, Charleston, W. Va.

1. A submarine mine comprising a float filled with compressed air, an attached bomb adapted to sink when released, a detent controlling the re-

lease upon reduction of air-pressure in the float, a slack cord rendered taut at a given depth under water, and means within the bomb to explode the charge of high explosive when the cord is taut.

1,306,395. PNEUMATIC SAW. John M. Abrams, Brooklyn, N. Y.

1,306,526. AIR-BRAKE. Frank S. Cravens, Lexington, Ky.

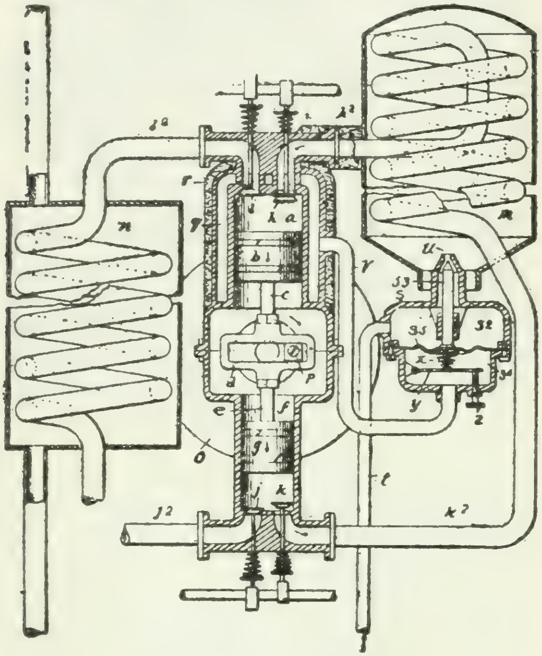
1,306,665. FLUID-PRESSURE BRAKE SYSTEM. James Amers Hicks, Atlanta, Ga.

JUNE 17.

1,306,680. COMPRESSOR. Georg Bernhard **Ax**, Stockholm, Sweden.

1,306,775. PNEUMATIC METAL-CATCHER. Alonzo J. Roberts, St. Louis, Mo.

1,306,865. PRIME MOVER. Elliott J. Stoddard, Detroit, Mich.



PATENT NO. 1,306,865.

1. In a caloric engine, a closed system, air under compression in said system, a working cylinder and a compression cylinder in said system, and automatically regulated means for raising the temperature of the air as it passes from the compression cylinder to the working cylinder so that it shall not have risen beyond a predetermined temperature when it passes to the working cylinder.

1,307,030. ELECTRIC WELDING SYSTEM. David H. Wilson, Paterson, N. J.

1,307,052. AUTOMATIC PLAYING ATTACHMENT FOR PIANOS. Alfred Johnson, Arthur C. Swanson, and Alfred H. Utterberg, Chicago, Ill.

1,307,061. COMPRESSOR FOR REFRIGERATING APPARATUS. Edwin O. Olsen, Milwaukee, Wis.

1,307,111. TURBINE-BLOWER. Axel W. Carlson, Worcester, Mass.

1,307,173. METHOD OF AND MEANS FOR INFLATING AND INTRODUCING SEALING LIQUID INTO PNEUMATIC TIRES. Daniel L. Anthony, El Paso, Tex.

1. The method of inflating, and introducing sealing liquid into, a pneumatic tire, which consists in puncturing the pneumatic tire, and then, through the opening thus made, introducing in a single operation into the pneumatic tire, first, a tire sealing liquid, and, then, compressed air in quantity sufficient to fully inflate the tire.

1,307,195. PNEUMATIC FOUNTAIN-PEN. Joseph F. Gardner, Kansas City, Mo.

1,307,280. PROCESS FOR THE RECOVERY OF GASOLENE AND OTHER HYDROCARBONS. William E. Walker, Arkansas City, Kans.

JULY 1.

1,308,051-2-3. MILKING APPARATUS. Reuben B. Disbrow, St. Paul, Minn.

1,308,095. APPARATUS FOR MANUFACTURING ARTICLES OF GLASS. William J. Miller, Swissvale borough, Pa.

1,308,137. APPARATUS FOR USING POWDERED FUEL. Charles D. Young, Altoona, Pa.

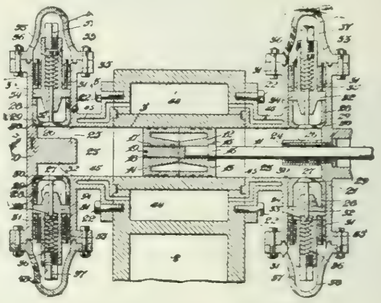
1,308,159. UNIT-ACTION FOR PNEUMATIC MUSICAL INSTRUMENTS. George P. Brand, New York, N. Y.

1,308,168. PONTOON FOR RAISING SHIPS. Andrew Courvoisier, Huguenot Park, N. Y.

1,308,170. FLUID POWER TRANSMISSION. Dimitri Sensaud de Lavaud, New York, N. Y.

1,308,191. PNEUMATIC-DESPATCH-TUBE SYSTEM. Emmett B. Perrine, Minneapolis, Minn.

1,308,288. AMMONIA-COMPRESSOR. Joseph Harvey McCain, Philadelphia, Pa.



PATENT NO. 1,308,288.

1,308,368-9. COMBINED AIR AND PULVERIZED-FUEL CONTROL. William O. Renkin, Oradell, N. J.

1,308,387. COMPOUND AIR-PUMP. Charles G. Bauer, Brooklyn, N. Y.

1,308,436. COMBINED FLUID-PRESSURE PUMP AND MOTOR. Robert Maw and William B. McLean, Montreal, Quebec, Canada.

1,308,464. APPARATUS FOR PNEUMATIC CONVEYANCE OF MATERIALS. Jens Westly, Lysaker, near Christiania, Norway.

1,308,472. ATMOSPHERIC GAS-BURNER. William Barratt, Coburg, Victoria, Australia.

1,308,557. CLIMB-INDICATOR FOR AIRCRAFTS. Benson R. Shaw, Dayton, Ohio.

1,308,569. APPARATUS FOR MEASURING GAS AND OTHER FLUIDS. Thomas B. Wylie, Pittsburgh, Pa.

1,308,603. APPARATUS FOR EXHAUSTING AND COMPRESSING AIR. David Morgan, Launceston, Tasmania, Australia.

W. G. Balph has been appointed manager of the safety switch section of the Westinghouse Krantz factory at Brooklyn, N. Y. As head of this section Mr. Balph will have entire responsibility for the sale of all Krantz products, and in addition will have charge of the extension and development of this very important line to meet the needs of the country for safety switches. Prior to working as salesman in the New York office, Mr. Balph was head of the fan motor division with offices at East Pittsburgh, Pa.

* * * *

Dr. Arthur A. Hammerschlag, director of Carnegie Institute of Technology, Pittsburgh, recently received the bronze medal awarded him by the Panama-Pacific International Exposition. He was a member of the international jury of awards at the exposition.

VOL. XXIV October, 1919 NO. X

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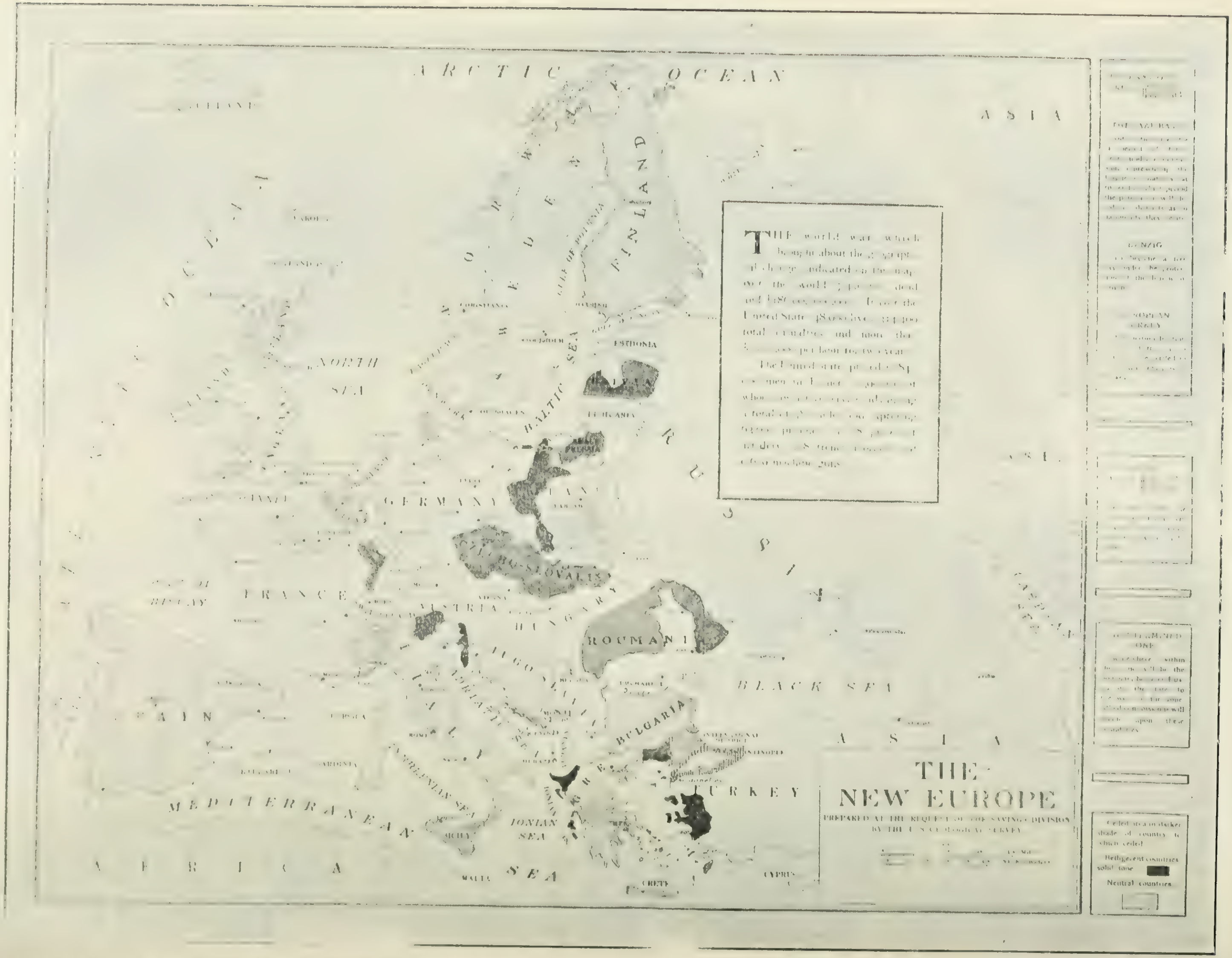


MAP OF THE NEW EUROPE AS SETTLED BY THE VERSAILLES PEACE TREATY. SEE KEY TO SHADED AREAS AT RIGHT.

COMPRESSED AIR MAGAZINE

Vol. XXIV OCTOBER, 1919 No. X

The Lure of the Lake Superior Copper Country

Mines, Mining and Miners and a Great Mining School—Air the Life Blood of an Industry Abounding in Thrills and Romance

By FRANCIS JUDSON TIETSORT

THE EYE of the intellect "sees in all objects what it brought with it the means of seeing," quoted Carlyle in his essays. For one to have been born and reared in a land of copper, to have had youthful imagination fired by tales of the riches of a Calumet & Hecla, to have fostered hopes of adventuring some day down a shaft extending a mile or more into the bowels of the earth, is to be on the *qui vive* with expectation when one's opportunity comes, say twenty-five years later.

Once in a while a rustic from his bucolic bowers comes to New York and tingles his vertebra for the first time by a ride in the express elevator of a skyscraper and then goes home to the crackerbox of the hamlet's general store to tell an audience all agape about his experience. If one has not ridden in an open skip down the inclined rockbound shaft of a great copper mine at the rate of 2,000 to 3,000 feet a minute, the route ahead into the murky depths lighted only by the miner's carbide lamp thrust into his cap, he may be pardoned for his merriment over the ruralite from Toonerville, but he will have a fellow feeling with the latter if he has made the mine trip by skip. Our very own excursion this summer down Osceola Shaft No. 15 of the Calumet & Hecla in Northern Michigan, will always stick out in memory as the big feature of our sojourn there, but of that incident, more later.

Midsummer found the writer in the Copper Country of the Upper Peninsula, clad in the longer balbriggans of autumn commerce, and overcoat, gloves and straw hat, the latter appurtenance of apparel seeming almost out of place. The invigorating clear air of always cold, deep and mysterious Lake Superior, the lake that never gives up its dead, that is shot with the Northern Lights, was blowing across Houghton and Hancock. Four to five hundred miles south and a thousand miles eastward the country was sweltering under a "heat wave." Up there, in a clime where there are two seasons, winter and summer, the former occupying more than two-thirds of the year, one found a head of steam in the radiators of the offices and surface buildings of the mining companies, and felt grateful for its warmth in the early morning hours.

To see something of the Copper Country was the avowed intent of our visit; to learn how practical copper mining men wrest the ore from the earth and convert it to the metal of commerce; to note how these men live and have their being; to observe the character of the land of their labors. We came away with something of a feeling that copper should be regarded as a precious metal, in peace or war, regardless of its market price; that it was fitting it should be recognized in every monetary system; that it was appropriate it should conduct the electrically flashed tidings of a world.

To describe copper mining would be to attempt to summarize processes pertaining to a highly systematized industry that has engaged the best efforts of great engineers for centuries past, and this has no part in our present purpose.

The Michigan Copper Range, since the discovery and development of the vast copper deposits of the Far West, has taken a secondary position in American production, the output being about

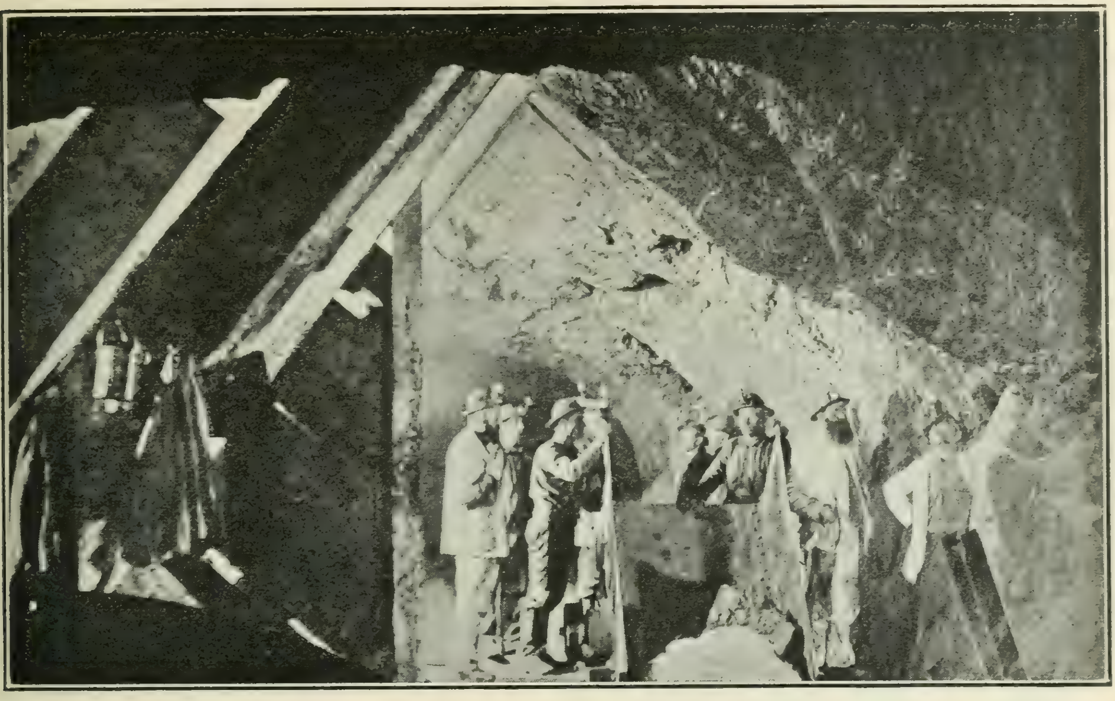
THIS IS AN HISTORIC PICTURE OF THE BEGINNING OF WORK ON SHAFT NO. 15 OF THE OSCEOLA (AMYGDALOID) LODE OF THE CALUMET & HECLA MINING CO., NEAR CALUMET, MICH. IT WAS DOWN THIS SHAFT THAT THE WRITER DESCENDED TO A DEPTH OF 2,700 FEET. THE FIGURE IN THE CENTER STANDING, WITH HIS HAND TO HIS HAT, IS THAT OF THE THEN MINE CAPTAIN, "JIM" HOATSON, A FAMOUS CHARACTER IN THE MICHIGAN COPPER COUNTRY, WHO HAS BECOME A MULTIMILLIONAIRE IN LESS THAN TWO DECADES.

ten per cent. of the total produced in the United States. But from the business side, these fine Upper Michigan properties continue to hold great potentialities for the development of wealth. There is now a renewal of expectation of increased production; in fact, the movement has already begun and miners are in demand on the Copper Range.

The American copper industry dominates the world's supply. After the armistice was signed production fell off from about one-third to one-half, because America and the Allies found themselves overstocked. The industry has now successfully passed the most trying phase of the reconstruction crisis. This has only been accomplished by the close coöperation of the operators. The surplus of red metal in this country, which in early summer amounted to twelve hundred million pounds, has been rapidly dwindling, but at this writing has not been wiped out by either contract or consumption. Nevertheless copper has been mounting in price and halcyon days again appear to buoy up both market and industry.

Depression was being followed by hopefulness when the writer was in Houghton. Copper had risen from the low of 14½ of early spring to 18½ cents in July. Some of the more optimistic thought there was a chance then for twenty-cent copper. There was a quiet tip abroad for everybody to buy good copper stocks. At the time we write, at the end of August, the best copper, which means Lake Superior copper, is at 23½ cents.

Optimism has been reflected most of the year by the porphyry companies of the west, in that



HERE IS AN UNDERGROUND SCENE OF MANY YEARS AGO IN THE CALUMET & HECLA. NOTE THE OLD-TIME LAMPS—TO SAY NOTHING OF THE WHISKERS.

there has been no change in their dividend rate. Take the twenty leading copper stocks as an average and they were selling in midsummer at only one-half a point below the prices of the date of the armistice. In fact Mr. John D. Ryan, head of the Anaconda group, took occasion to raise his voice against carrying prices too high. Sales have been exceeding what was the monthly production of 115,000,000 pounds, for the entire country, but this was only about two-thirds of the copper production rate of 1917 and 1918. The general business expansion means increased movement of copper this year and then, too, export orders are on the way. Those who have been hanging on their copper shares and taking on more are winning out. And everybody in the Northern Michigan Copper Country dabbles in copper stocks—it's as natural with folk there as shooting African golf is in Baltimore.

While on this phase of the subject it might be well to note in passing that the example of the Copper Export Association is being followed by a silver export association, members of which are determined to break the grip of the four London brokers who have so long controlled the price of the white metal. This new silver combination is being formed under the provisions of the Webb law. Some of the copper producers of Michigan and the west are also silver producers.

Lake Superior copper is worth a cent or more a pound in excess of other copper because of its greater ductility, which is a result of its peculiar molecular construction. The sulphide copper of the west, which incidentally goes through the same electrolytic process, shows a different chemical result when reduced to ingots. So all copper is not "just copper."' It differs. Michigan copper is better for the electrical trades, for sheathing ships, for roofs and many particular requirements. An added advantage in the mining of Michigan copper is that the lodes run true to calculations—with almost mathematical exactness.

The Michigan mines, along with those of Montana, Arizona and Alaska, comprising the world's richest producers, are enabled now, with copper at from 23 to 24 cents, to make a handsome profit, even with production at little more than fifty per cent. capacity. The copper industry, of course, has largely been assisted by governmental action in carrying the copper surplus, but in coming months foreign and domestic demand is expected to wipe out this surplus, and a stabilized industry will then stand on its own foundation without having been subjected to dangerous losses. As copper is one of the prime essentials in the world's affairs, critics of governmental assistance have been answered with the retort that it was as fitting to protect copper as it was to stabilize wheat for the farmers.

Copper mining began actively in Northern

ANOTHER OLD PICTURE TAKEN IN THE SEVENTIES SHOWING A GROUP OF MINERS AT THE CALUMET & HECLA. NOTE THE OLD WOODEN SHAFT HOUSES (NOW SUPPLANTED BY STEEL) AND THE YOKED OXEN, IN THE BACKGROUND.

Michigan about the same time as iron mining, in the early forties, and the writer encountered a few very old-timers who were able to recall those days. The existence of both copper and iron in the region, however, had been well known to white pioneers and explorers since shortly after the opening of the eighteenth century. There is evidence that the aboriginal Indians took out copper, using it for utensils and weapons, and that they even succeeded in tempering it to a degree.

There are more than a score of large producing copper mines in Keweenaw Peninsula and its vicinity, among them the original and world-famous Calumet & Hecla, which was long known as the most profitable copper mine in the world. Up to a decade ago it had earned dividends of $107,850,000 and since that time $2,900,000 in 1910; $2,400,000 in 1911, $4,200,000 in 1912, $3,200,000 in 1913, $1,000,000 in 1914, $5,000,000 in 1915, $7,500,000 in 1916, and $8,500,000 in 1917. The total to Dec. 20, 1917, was $145,250,000, or $1,450.25 per share, being the largest dividends ever paid by any incorporated mining company, and in addition, the Hecla Mining Co., and the Calumet Mining Co., before their amalgamation under the present title paid dividends aggregating $950,000. Dividends received from other mining companies amounted to $2,226,930 in 1916. During 1917, C. & H. paid three dividends of $25 per share and one of $10, the last being reduced to conserve cash resources for heavy Federal taxes, estimated at between $2,000,000 and $3,000,000 for 1917.

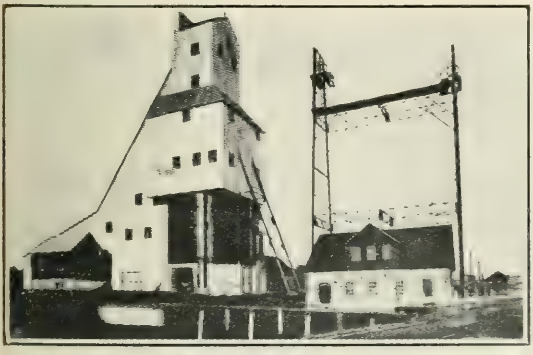
According to Walter Harvey Weed's *Mines Handbook,* 1918, since the change in charter, 1905, permitting the acquisition of stock in other corporations, the Calumet & Hecla has procured control of various other mines and mineral tracts, by organizing subsidiary corporations, and also by acquiring stock in companies previously organized. In 1905 the company bought the following stocks, at a cost of $8,592,129.99 in cash and notes; 9,600 shares of Osceola; 19,400 shares of Tamarack; 24,796 shares of Ahmeek; 27,507 shares of Isle Royale; 10,316 shares of Seneca; 25,000 shares of Laurium. The effort to obtain actual control of the Osceola Consolidated Mining Co., at the annual meeting of March, 1917, was met by opposition which took the contest into the Michigan Legislature and the Federal courts. After nearly two years of strenuous litigation, the Calumet & Hecla obtained control of the Osceola and other Superior Mining companies formerly under the management of A. S. Bigelow by means of an agreement with Mr. Bigelow, by which his entire stock interest was disposed of to the Calumet & Hecla. From the

A VIEW OF THE MAIN STREET OF HOUGHTON, MICH., SHELDEN ST., SHOWING IN THE LEFT FOREGROUND A PORTION OF THE HANDSOME HOUGHTON CLUB. HERE FOREGATHERS THE FAMOUS "ROCK HOUSE GANG," AS IT IS FACETIOUSLY CALLED, NUMBERING MEN OF LARGE AFFAIRS IN THE "CAPITAL" OF THE MINING COUNTRY. BEYOND THE CLUB IS THE PRINCIPAL HOTEL OF A TOWN WHICH IS CALLED "THE BIGGEST LITTLE CITY IN THE UNITED STATES."

same *Handbook* we have abstracted the physical facts about the properties that follow:

In 1916, Calumet & Hecla offered to purchase the remaining shares of Tamarack Mining Co.; but owing to differences regarding price the matter was not consummated until June 25, 1917, when the C. & H. Company agreed with Tamarack shareholders and the former acquired the assets of the latter. The Tamarack mine now belongs to the C. & H. Co.

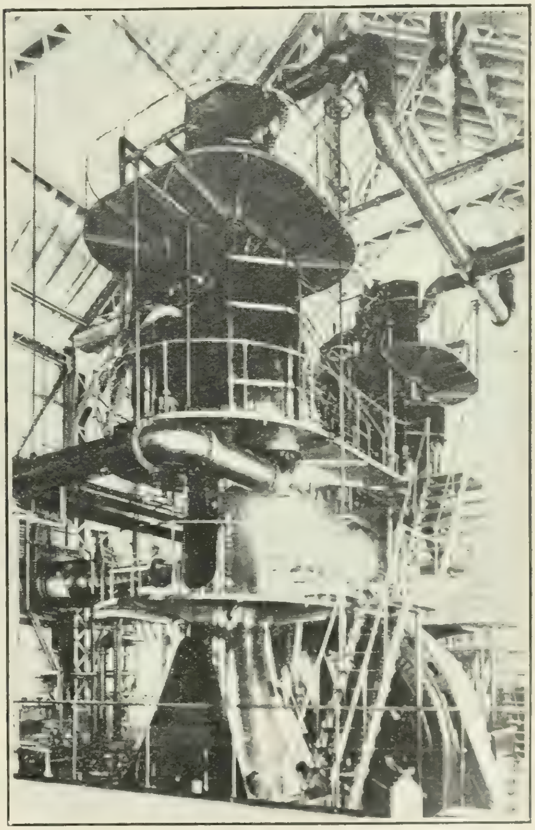
The share holdings of the Calumet & Hecla in subsidiary companies were as follows as of date, December 31, 1916: 41,000 shares of Allouez Mining Co.; 41,500 shares of Centennial Copper Mining Co.; 19,400 shares of Cliff Mining Co.; 50,100 shares of Gratiot Mining Co.; 152,977 shares of La Salle Copper Co.; 32,750 shares of Osceola Consolidated Mining Co.; 50,100 shares of Superior Copper Co.; 39,288 shares of Laurium Mining Co.; 32,910 shares of Isle Royale Copper Co.; 98,048 shares of Ahmeek Mining Co.; 19,400 shares of Tamarack Mining Co.; 34,259 preferred shares and 42,602 common shares of White Pine Copper Co.; 3,482 shares Calumet Transportation Co.; and 2,000 shares in Great Lake Transportation Corporation. The Frontenac Manitou, Dana and St. Louis companies have been completely absorbed.



A MODERN SHAFT HOUSE OF QUINCY MINE NO. 2, HANCOCK, MICH., CONSTRUCTED OF STEEL, MASONRY AND CONCRETE.

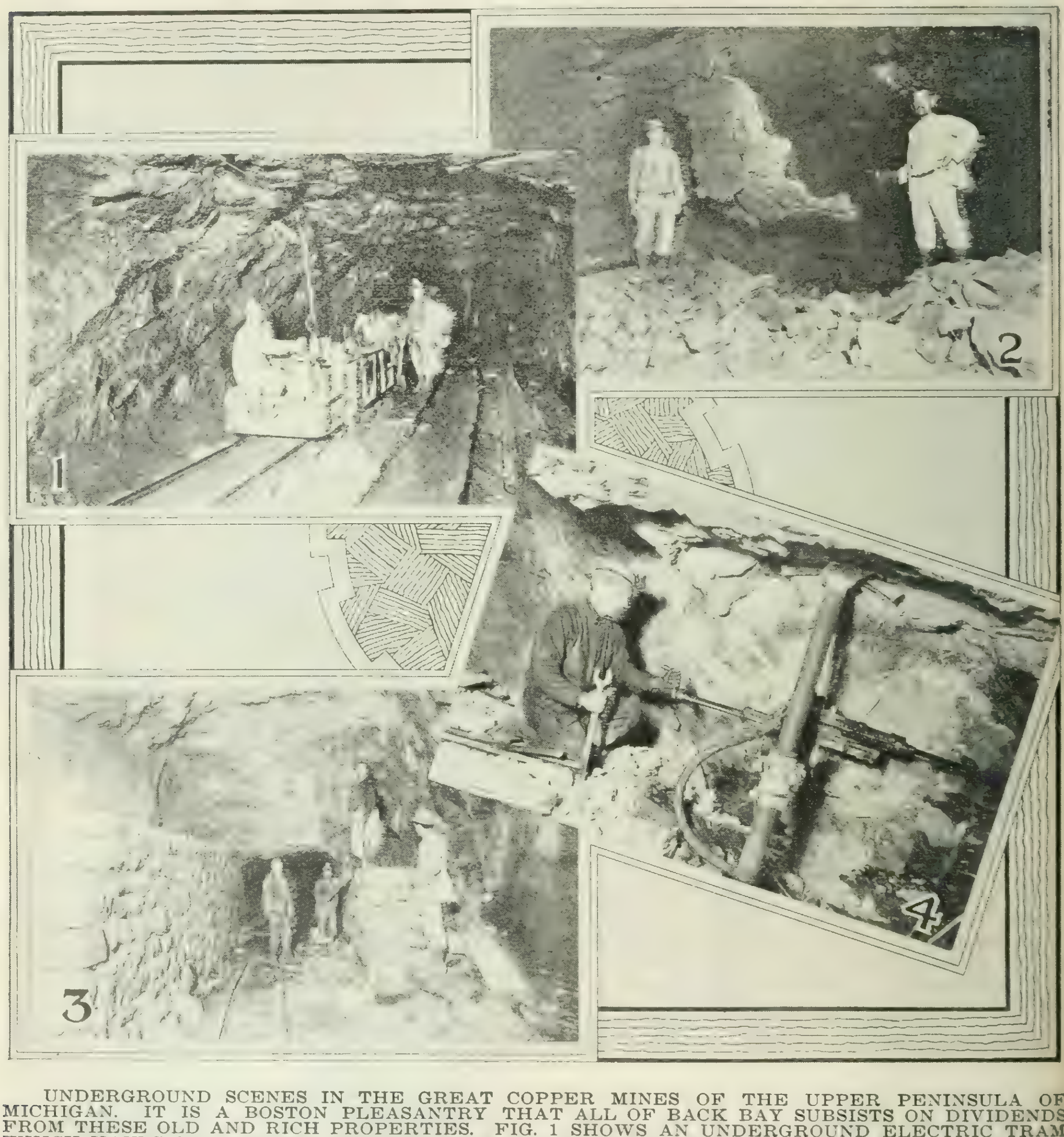
On December 23, 1916, the company sold its 11,207 shares of Seneca Mining Co. for $60 per share, a total of $672,420. The C. & H. has no further interest in the Seneca.

The landed holdings of the Calumet & Hecla, including the property owned outright, property controlled through subsidiary corporations, mining lands under options, and timber and miscellaneous lands, in Houghton, Keweenaw and Ontonagon counties, Michigan, amounts to approximately 209,051 acres, of which 102,804 acres are in Keweenaw county. The company, with its subsidiaries, has a waterfront of more than 34 miles, on Lake Superior, Lac La Bele and Torch Lake, and approximately 60,000 people are supported by the operations of the company and its allied interests.



JUMBO HOIST OF THE CALUMET & HECLA. THIS MIGHTY PIECE OF MACHINERY OPERATES SKIPS UP AND DOWN SHAFTS FOR THOUSANDS OF FEET AT GREAT SPEED. RIDING ON THESE SKIPS AND GOING UNDERGROUND, A PRIVILEGE FEW OUTSIDERS GET, GIVES A THRILL TO THE UNINITIATED VISITOR. PASSES ARE ISSUED ONLY BY THE PRESIDENT OF THE COMPANY IN WRITING.

The original Calumet & Hecla mine, which the writer visited among others, is opened on the Calumet conglomerate bed, and a parallel mine has been developed on the Osceola amygdaloid lode, while



UNDERGROUND SCENES IN THE GREAT COPPER MINES OF THE UPPER PENINSULA OF MICHIGAN. IT IS A BOSTON PLEASANTRY THAT ALL OF BACK BAY SUBSISTS ON DIVIDENDS FROM THESE OLD AND RICH PROPERTIES. FIG. 1 SHOWS AN UNDERGROUND ELECTRIC TRAM WHICH HAULS OUT LOADED ORE CARS TO THE INCLINED SHAFTS, UP WHICH THE ORE IS CARRIED IN SKIPS AT THE RATE OF 2,000 FEET A MINUTE. FIG. 2 SHOWS MASS COPPER HANGING FROM THE SIDE WALL OF A DRIFT. FIG. 3 SHOWS A DRY WALL OF ROCK IN THE TWELFTH LEVEL OF A MINE (1,200 FT. UNDERGROUND). FIG. 4 SHOWS A MINER DRILLING WITH A NO. 18 LEYNER-INGERSOLL MOUNTED ON COLUMN AND ARM.

a third parallel mine has been partly developed on the Kearsarge amygdaloid.

The conglomerate mine, which, until a few years ago, was the entire Calumet & Hecla, has a future life, at the present rate of production, of at least eight to twelve years, it is estimated, followed by five to ten years of scramming, with decreased output. The conglomerate has decreased in average copper contents with depth, but output averaged in 1915, 3.36 lb., and 1916, 3.59 lb. more than in 1914, partly because old pillars, etc., were worked out. The mine works normally 175 power air drills on the conglomerate and 125 air drills on the amygdaloid.

During 1916, there were 78 air drills at work removing shaft-pillars, cleaning up arches and backs of stopes. This yielded 476,310 tons of ore.

The conglomorate property of the Calumet & Hecla is worked as two separate mines, known as the Hecla and the Calumet branches, the south Hecla being a southerly continuation of the Hecla branch, and the Red Jacket branch vertical share a part of the Calumet mine. The Calumet to the north, the Hecla in the center, and the South Hecla at the south from one continuous mine, developing the Cal-

HOW DRILLING FOR BLASTS TO REMOVE ORE IS DONE UNDERGROUND IN THE GREAT COPPER MINES OF NORTHERN MICHIGAN. THIS VIEW SHOWS MINERS OPERATING A NO. 148 LEYNER-INGERSOLL DRILL MOUNTED ON A TRIPOD. Photo Courtesy Ingersoll-Rand Co.

umet conglomerate by incline shafts, the Red Jacket shaft opening the same bed vertically.

The conglomerate opened for two miles along the outcrop, has eleven shafts, eight being known as single compartments, which means a single hoisting compartment with two shafts having two hoisting compartments and one vertical shaft having six compartments. The blind shaft has an electric hoist and the mine has electric station pumps for forcing water to surface with steam pumps acutated by compressed air for short lifts, but it is planned replacing these latter by electric pumps also.

The amygdaloid mine of the Calumet & Hecla is opened on the Osceola amygdaloid bed, which outcrops 730 feet east of the Calumet conglomerate, with parallel strike and average dip of about 38 degrees, underlying the entire main tract of the Calumet & Hecla mine. There are six shafts in the amygdaloid mine, Nos. 13 to 18 inclusive, numbered from south to north. Shafts are duplicate in size, each having three compartments, of which two are used for hoisting and one for pipes and ladder-ways. The amygdaloid has over 35 miles of workings and has frequent connections with the conglomerate by crosscuts. The amygdaloid was closed 1901, and reopened 1904. In this mine the Osceola bed runs about 35′ in width, with principal values along the foot and hanging, the middle third being lean, as a rule.

Laterals in the Osceola workings are carried as drift stopes of 12′ height along the hanging wall. The Calumet & Hecla owns on its main tract, about 11,000 feet of the strike of the Osceola bed. Developed ore reserves of the amygdaloid mine were estimated January, 1916, at 6,000,000 tons, and the Osceola bed has been found to carry fair copper values, at a vertical depth of one mile in the Tamarack property.

As the mills stand on the flat western shore of Torch Lake, but little above water level, tailings speedily fill the shallow lake for some distance off shore, and to deposit the sand it became necessary to attain a considerable initial elevation, which is gained by sand wheels. The material entering the mills as conglomerate rock leaves as coarse sand to the extent of fully 6,000 tons daily. The sludge is washed through launders to the sand houses, where it is scooped up by the buckets of the wheels and dumped, high above into launders running on trestles far out into the lake, these spouting forth miniature brick-red Niagaras. There are two wheel houses, one for each mill.

The Calumet wheel house has sand wheels of 50′ diameter, and the Hecla 50′ and 64′ diameter. The

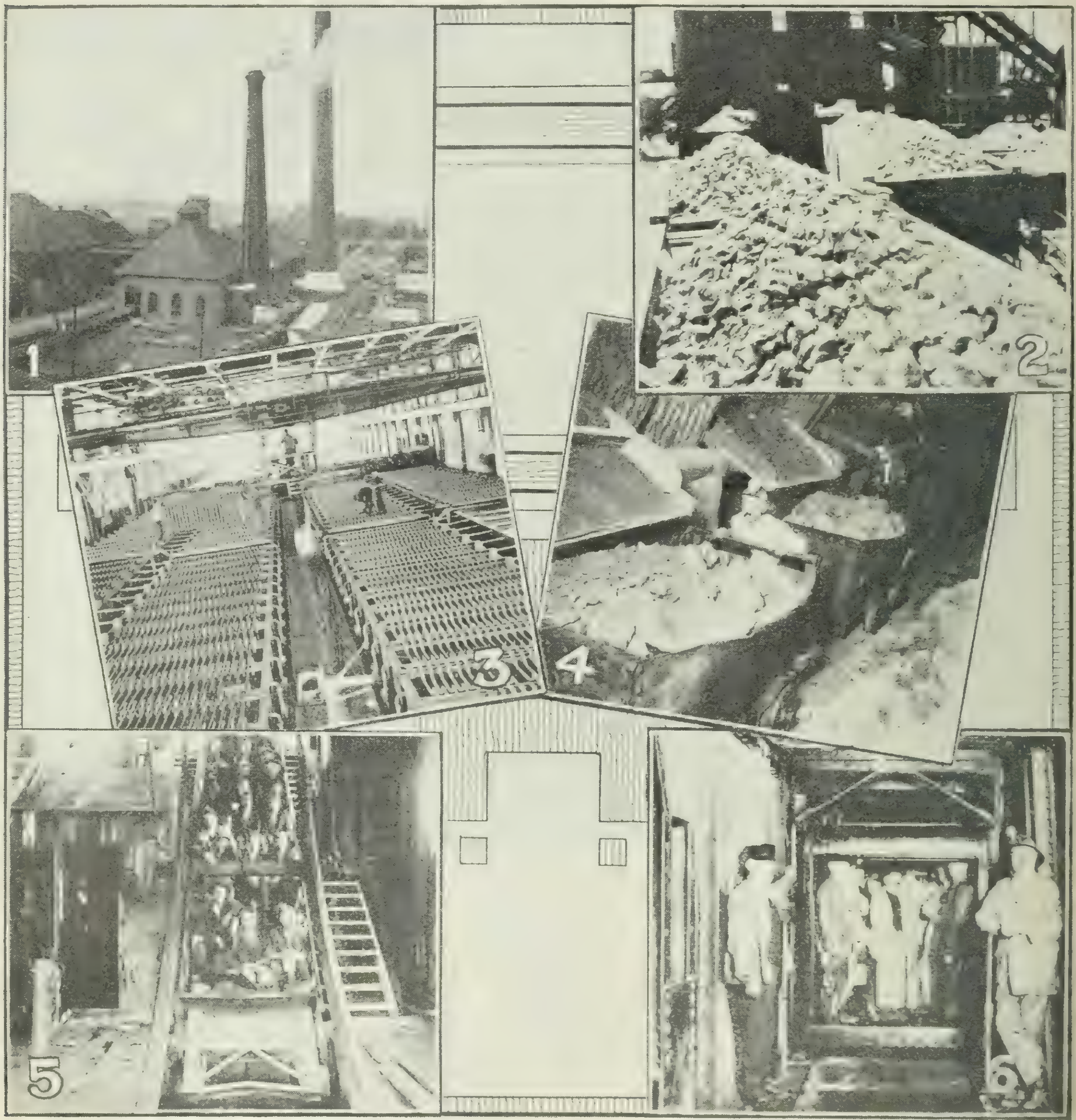


FIG. 1 SHOWS NORTH SUPERIOR BOILER HOUSE AND SHAFTS ON THE CONGLOMERATE LODE, CALUMET & HECLA MINES, CALUMET, MICH. FIG. 2—LOADING CARS WITH CRUSHED ROCK TO BE SHIPPED TO MILLS. FIG. 3—SEPARATING PURE COPPER BY MEANS OF ELECTRICITY. FIG. 4—AT ONE MILE UNDERGROUND LOADING AND HANDLING CARS WITH COPPER ORE. FIG. 5—SKIP FILLED WITH MINERS GOING TO WORK, 5,000 FEET BELOW SURFACE, DOWN INCLINED SHAFT. FIG. 6—MINERS DESCENDING 6,000 FEET IN RED JACKET SHAFT, LONG KNOWN AS THE DEEPEST VERTICAL SHAFT IN THE WORLD.

sand wheel is to all appearances a gigantic bicycle wheel, fitted with spur gearings where the rubber tires should be. The complete wheel weighs 500 tons, and is mounted upon massive concrete masonary. Four 25-ton iron bedplates support the pillars carrying the 21-ton Krupp forged steel axle, which is 27′ long and 32″ in diameter with a hollow core of 26″ diameter. Radiating from axle to rim are 2″ steel spokes 32′ long. The completed wheel is 10′ wide and 64′ in diameter, driven by gear and pinion, power being furnished by a 700 horse power dynamo, and has a capacity of 55,000 gallons per revolution. Nearly two years' time was required to build and adjust this monstrous wheel.

Water for the mills is supplied by four pumps, of which the "Michigan" is the most powerful in the world, having a daily capacity of 60,000,000 gallons. Auxiliary pumps are the "Huron" and "Ontario" of 20,000,000 gallons capacity each, the "Erie" of 10,000,000 gallons and an IP Morris pump of 32,000,000 gallons daily capacity.

The electrification of the Calumet & Hecla was

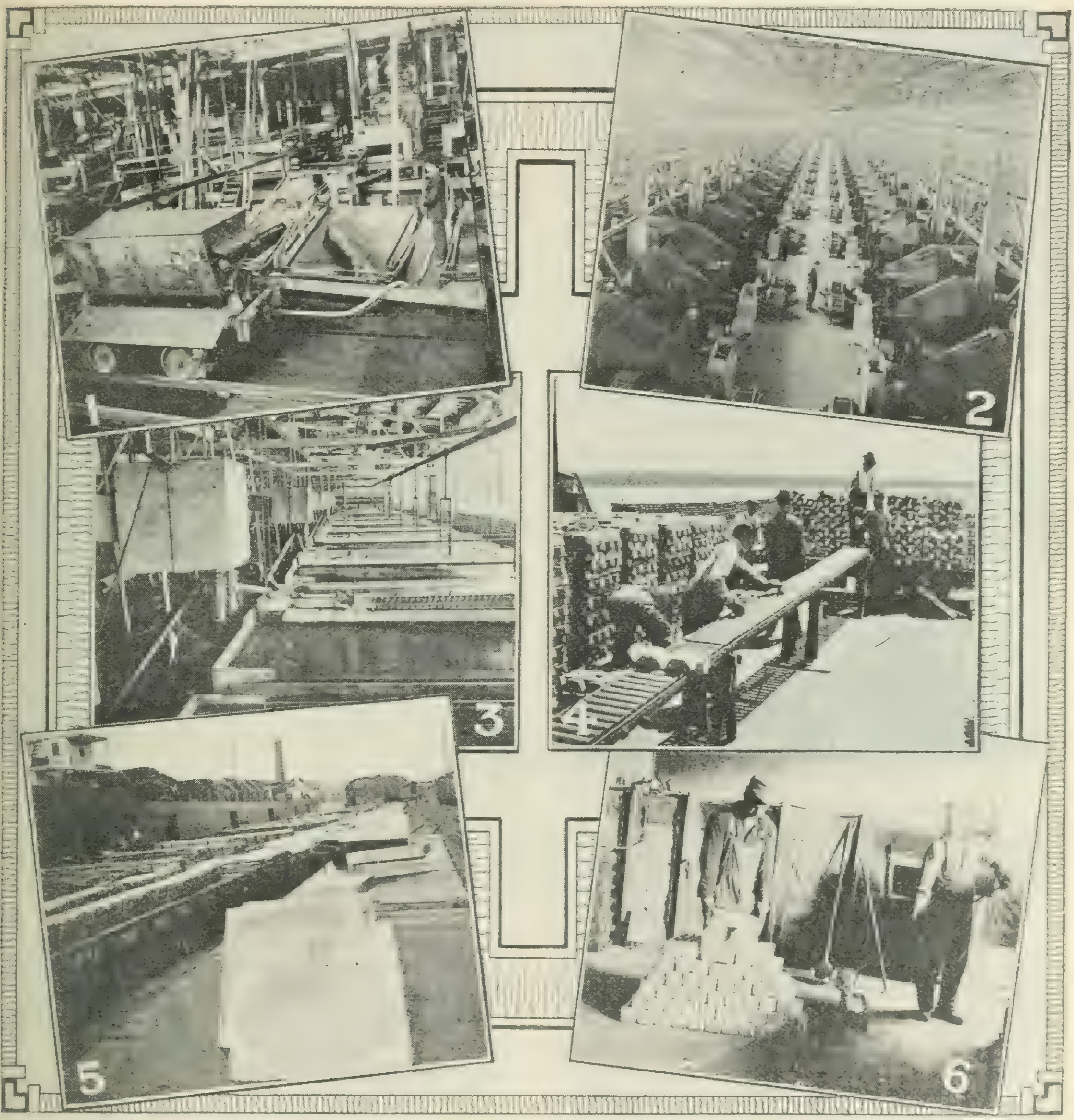
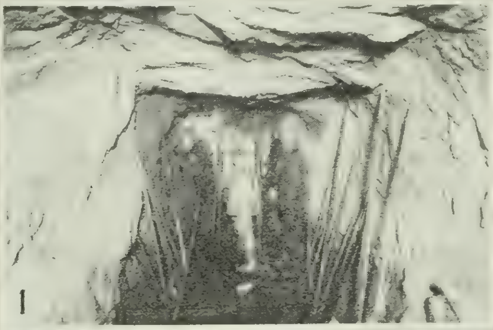


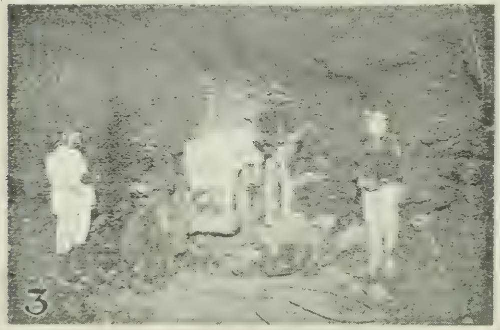
FIG. 1—CALUMET & HECLA MILLS AT LAKE LINDEN, MICH., SHOWING JIGS, SCREENS AND TABLES. FIG. 2—PEBBLE MILLS OF PLANT FOR REGRINDING COARSE SAND. FIG. 3—WIFLEY TABLES IN REGRINDING PLANT SHOWING DISTRIBUTING BOX AND PIPES. FIG. 4—THE UNLOADING OF COPPER INGOTS ON PIER, LAKE LINDEN, MICH., FROM FREIGHT CARS. FIG. 5—LOADING 1,400 TONS OF COPPER INGOTS ON BOARD A GREAT LAKES STEAMER. FIG. 6—SILVER SOMETIMES OCCURS IN COPPER ROCK. THIS VIEW SHOWS A WORKMAN POURING SILVER BULLION, THERE BEING 55 BARS IN THE PICTURE, WORTH MORE THAN $50,000. THIS SILVER WAS RECLAIMED IN ONE MONTH.

begun in 1904 and eventually will be completed, at mines, mills and smelters, except for some of the big compound hoists and air compressors at the mines, where a change from steam to electricity would be a doubtful economy as well as necessitating enormous initial outlays.

Subsidiaries of the Calumet & Hecla Mining Co. are these companies: Ahmeek, Allouez, Centennial, Cliff, Gratiot, Isle Royale, La Salle, Lake Superior Smelter, Laurium, Osceola, Superior, Tamarack and White Pine Copper Co. The Calumet & Hecla officers and operating heads are:

Rodolphe L. Agassiz, president; James Mac Naughton, vice-president and general manager; Francis L. Higgison, Robert F. Herrick and W. Hunnewell, directors; John F. Perkins, secretary-treasurer; Charles A. Hall, assistant treas-





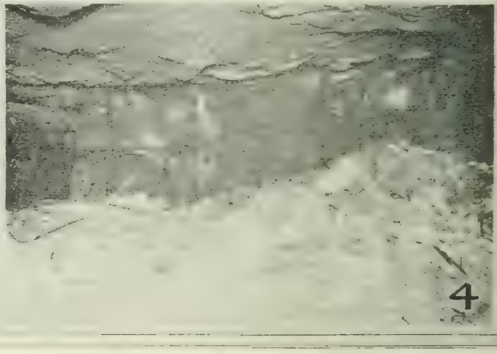


FIG. 1—SHOWS AN UNDERGROUND VIEW IN THE TRIMOUNTAIN MINING COMPANY'S PROPERTY AT TRIMOUNTAIN, MICH., WHERE DRIFTING IS BEING DONE WITH TWO NO. 18 LEYNER MACHINES. FIG. 2—ILLUSTRATING A MUCKING AND TRAMMING JACKHAMER IN USE FOR BLOCKHOLING OR BREAKING BOULDERS IN THE NO. 4 SHAFT, 11TH LEVEL OF THE CHAMPION COPPER CO. AT PAINESDALE, MICH. FIG. 3—NEAR VIEW OF A JACKHAMER IN THE CHAMPION MINE BREAKING BOULDERS ON THE FIFTH LEVEL. FIG. 4—TWO MOUNTED JACKHAMERS ENGAGED IN STOPING ON THE THIRD LEVEL OF SHAFT NO. 4, CHAMPION MINE.

urer; A. J. Garceau, assistant secretary; W. M. Gibson, assistant superintendent; E. S. Grierson, chief engineer; John Knox, chief mining captain; Ocha Potter, chief efficiency engineer; Fred S. Eaton, chief clerk; E. D. Johnson, purchasing agent.

The mill office is at Lake Linden, Mich., where Henry Fisher is superintendent and C. H. Benedict is mill metallurgist. At the smelter office at Hubbell, Mich., H. D. Conant is superintendent.

The Calumet & Hecla Mining Company, which has we have noted, eventually came to control a considerable group of profitable mines, among them the richest producers in the Keweenaw area, has had a career as a corporation matched by few if any other mining corporations in the world. The control of the company long lay among old Boston families, and it is a pleasantry at The Hub that all Back Bay subsists on its C. & H. dividends. The beauty and chivalry of C. & H. aristocracy has been a happy foil against the Boston background for the less highly esteemed elite created by the sacred codfish; at least such is held as a self-evident truth by the haughtiest of the Bostonese *haut ton,* those of the copper persuasion.

The quantity of copper mined increased from 12 long tons in 1845 to 102,543 in 1906, and during the four decades from 1847 to 1887, Michigan's copper product exceeded that of any other state in the Union. In fact, from 1847 to 1883, its production exceeded one-half of all the states, but after 1887, excepting the year 1891, more copper was mined in Montana than in Michigan, and in 1906 and 1907, the yield of both Arizona and Montana exceeded that of Michigan.

To get the copper out to market and to facilitate transportation to and from Houghton and Hancock, it was found advisable to connect long and narrow Lake Portage with its mighty neighbor, Lake Superior, and this was done by a canal dug by coöperation between the state and national governments. The federal government contributed land and the canal was completed in 1873, passing under federal control in 1891.

The writer had the advantage of arriving in Houghton, "Capital of the Copper Country," and seat of the world renowned Michigan School of Mines, by water, coming through the channel from Lake Superior to Portage Lake, where the country still has a wild and primeval appearance in spots. A few hours after leaving Detroit by steamship, the automobile metropolis having been blistering under a temperature high in the nineties, one's overcoat felt very comfortable on deck in Lake Huron in the evening hours and it was a warming and welcome companion for the next fortnight. As the good ship *Octorara* continued to plough northward into the cold waters, the temperature dropped. Coffee and rolls were succeeded as a matutinal meal by a steak and eggs and a keen appetite for generally more substantial fare at meals was experienced. One did a mile constitutional around the promenade deck to keep the blood circulating. After touching at Mackinac Island for a few hours, the ship headed once more northeast for St. Mary's River and on midnight of the second night out from Detroit was locked through the gigantic single lock of the Sioux Ste. Marie Canal, where in one lift the steamer was brought up to the Lake Superior level.

On the third day the vessel passed the Pictured Rocks of the south shore of the world's greatest fresh water body, the great inland sea of Superior, and all day churned her way westward, passing mighty iron ore carriers downward bound to Lake Erie ports. Some of the craft are 600 feet in length, and constructed with the idea of clear deck space, have from 25 to 30 hatches, into which their heavy cargoes are chuted so rapidly that their "turn-around" time at destination ports is a matter of hours as against the days it requires for transocean ships at Atlantic ports.

In the early evening of a glorious northern summer day, under a sky shot with gold and with startling color effects extending down to the western horizon, we finally doubled the lower end of the Keweenaw peninsula to the southeastward and entered the government channel leading into Portage Lake. The old pilings keeping the channel in bounds showed the effects of many winters of heavy ice, and the foliage and flora observable were seen to be of a northern latitude where old Boreas holds sway for the greater part of the twelvemonth. As one rugged specimen of the climate put it, "We have nine months of winter up here and three months of right coolish weather." It is a clime that certainly puts vim, vigor and vitality into the human frame, in its milder moods, and when once the deeply penetrating frosts are in the ground and the fences are snowed under for the long winter and the automobiles are stowed away, it is a land either to kill or cure any effete tenderfoot living under the moderating influence of the Gulf Stream.

The climate showed the minute we landed from the steamer in Houghton. Now Houghton isn't a very big town as far as gross population goes, some six or seven thousand, but it certainly has a "git-up and git" atmosphere about it, as the late Alfred Henry Lewis used to say, that is engaging to one who knows how hard folk jostle each other to get out of the Subway first, in New York, and then stand on the street curb for five minutes after their mad rush, wondering what to do next. In New York and Chicago people hurry and hurly-burly their way about from habit and from the effects of nervous environment, but in Houghton, or its twin city across the Lake Portage patch of water, Hancock, the climatic ginger working internally causes folk to hustle to and fro from fixed motive.

Fifty automobiles were lined up at the pier to take passengers to their homes in the surrounding towns and they all seemed glad to get back home. One college girl from the University of Michigan at Ann Arbor exclaimed with more force than collegiate elegance, "Gee, I'm sure some glad to get back home up here where you can stretch and take a long breath without busting something!" She greeted her "pops" with a bear-like, athletic hug, leaped into the family car and off they tore for Calumet with true Copper Range "pep."

Up in this region is what would be a shirt-sleeves democracy were it not for the climate. Substantial old clothes take their place for workaday use, and miner rubs elbows with millionaire in daily contact. It is "Hello, Bill," and "How are you, Dick?" on every hand. At the clubs and for social gatherings, however, one will find the men as smartly apparalled and the women as modishly gowned as would be expected in more metropolitan places. There is an open-handed and open-hearted hospitality and heartiness about the people that one associates with the far west.

The writer was fortunate in having as his cicerone, friend and assistant in obtaining facts and the accompanying photographs to illustrate this article, Mr. Lewis Dixon Knight, manager at Houghton for the Ingersoll-Rand Company, a man familiar with western as well as northern mining in this country and having had experience in South Africa, Australia and South America.

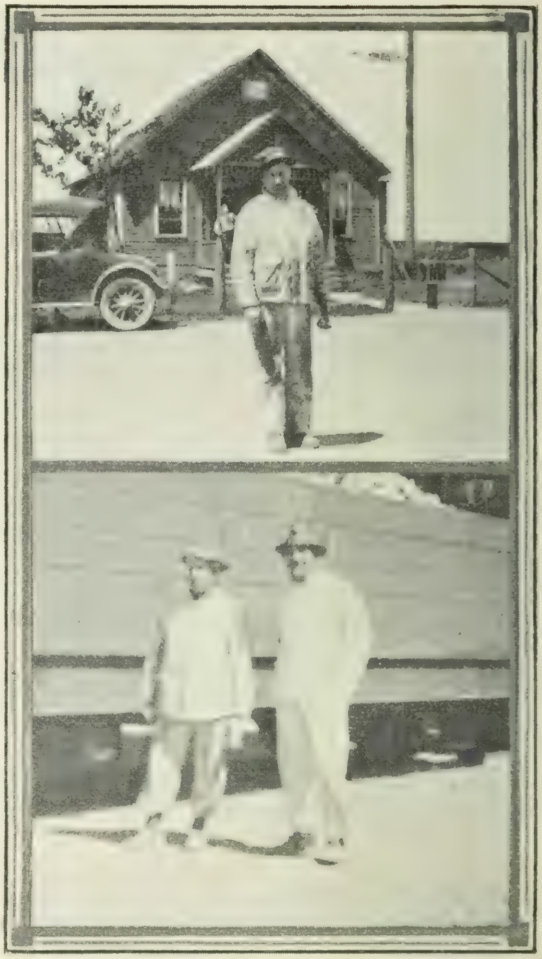
Acknowledgments are made for his highly valued help in motoring us from one mining property to another and making the rounds of the other authorities.

Not the least interesting event, as has been previously indicated, was going underground, the trip having been of three-hour duration. After receiving authority from Mr. John Knox, Mr. Knight and Mr. Samuel Richards, head mining captain of the amygdaloid lode, escorted the writer down No. 15 shaft of the Osceola. After changing from street clothes to underground rigs and being equipped with carbide lamps, we repaired to the shaft, and were presently seated in the front of the skip in readiness to descend into the depths. With Captain Richards it was part of the day's work, with Mr. Knight an old story, with the writer it was a distinctly thrilling incident.

We have shot the chutes, looped the loop, dashed down scenic(?) railways, ascended a mile in an airplane, climbed to the crow's nest and thence to the gilt ball atop a ship's spar, hung over a rocky ledge on a mountain top, ridden out a hurricane at sea, walked an eight-inch plank with a hundred feet of open air beneath us, ascended the Corcovado on a cog road at horrific grade and rounded a sharp curve in the cab of a locomotive travelling seventy-five miles an hour, but from none of these things did we ever derive quite the same thrill as came to us as we shot down that shaft toward China at the rate of 2,000 or more feet a minute.

It was not a bit fearsome, merely stimulating and exciting—a brand new sensation. Rushing down through the rocky walls, with the passage of air fanning one, there comes a feeling of pleasure. One relaxes his muscle tension after a few hundred feet of it and is perfectly willing to keep on going as long as they will let him; willing to let nature take its course. The thought occurred that if the cable broke it would certainly be considerable of a ride into the next world, with the final fireworks at the bottom, thousands of feet underground, only a means of floating off into the eternal ether of illimitable space. This fancy seized our mind for only a second—the rope didn't break!

The skip suddenly came to a jerky stop at the seventeenth level and our musing ended as we stepped out to inspect the true inwards of the mine workings. After our inspection on this level we climbed backward down an ordinary prosaic ladder of scantlings and iron rungs, in hundred foot stretches between the seventeenth, eighteenth and nineteenth levels and from the twenty-third to the twenty-fourth and twenty-fifth levels. Between the nineteenth and twenty-third we rode by skip again, but the other 500 feet was negotiated by leg power alone and with perceptible effect on the back muscles. We are pleased to recall that we returned all the way to the surface by skip.



AT THE TOP OF THIS PICTURE IS SEEN MR. LEWIS DIXON KNIGHT, MANAGER OF THE INGERSOLL-RAND CO., HOUGHTON, MICH., WHO ACCOMPANIED THE WRITER, AT RIGHT OF LOWER PICTURE, UNDERGROUND 2,700 FEET IN THE OSCEOLA MINE, SHAFT 15, UNDER THE GUIDANCE OF CAPT. SAMUEL RICHARDS, AT LEFT IN LOWER PICTURE, CHIEF MINE CAPTAIN OF THE OSCEOLA LODE OF THE CALUMET & HECLA COMPANY.

There were no untoward incidents, excepting that while Capt. Sam Richards was explaining what a safe and healthy life the miner leads, a couple of tons of copper rock in one chunk came bounding down several hundred feet out of upper darkness where some muckers had loosened it and deposited itself not more than a score of feet ahead of us. This wasn't very near, of course, and we admitted it must be a great life, if one didn't weaken. We could see plainly that for us the hardest part would be the first hundred years in the game.

But they are a fearless, hard-fisted, fighting crew of workers, these mining men, and there is a fascination in their tasks for them, in the conquering of the stubborn rock, in wresting out the metal held in bondage millions of years. They stick with it year after year and with brain and brawn outwit nature. Capt. Sam Richards was a fine type of miner. He was reared within a few hundred yards of the shaft down which he escorted us. He started as a drill boy and has been mining it for twenty-seven years since. He has run the whole gamut of practical copper mining, from timbering to time keeper, and for eleven years has been captain of the six shafts on the amygdaloid lode. He is the idol of his men, any one of whom will cheerfully go out and fight for him on the slightest provocation.

Mining is here conducted first by shaft sinking to the depth required to connect with the lode, then by development along the vein in laterals or drifts. The method of mining in this region is so well known as scarcely to require consideration here. The modern types of water hammer drills are used to bore into the rock for the blasting, the largest proportion of them being Leyners of the Ingersoll-Rand make. Many Jackhamers of the same make are utilized for shaft repair work and foot-wall work and blockholing. The average air pressure used is around seventy pounds. The multiplied uses of compressed air have of course transformed all mining and it has long since become the life blood, a prime essential, of the industry.

The mines have been running in two eight-hour shifts since the armistice, a night shift of from 7 p. m. to 3.30 a. m. and a day shift between the same hours, the blasting being done at night and the fumes being blown out between shifts. In the blacksmith shops of the C. & H. district there are employed 43 Ingersoll-Rand Leyner drill sharpeners, five Waugh sharpeners and two Sullivan sharpeners. Single Carr bits are used by all the mines with the exception of the Copper Range, the Wolverine and the Mohawk, which use double Carr bits in from one-foot to two-foot changes.

The new No. 2 shaft of the Seneca Copper Corporation is an interesting development of the region. This shaft was begun Feb. 15, 1918, the dimensions being 19′ 4″ x 9′ 4″. A great record was made in shaft-sinking, the rates on vertical work for the first five months being respectively, 208′, 195′, 202′, 205′, and 184′, a total of 994′. The inside of the shaft is lined with concrete. Up to May 1 of this year the shaft had been sunk to 1746′ and in July it had reached 1820′. The 600′ radius of this compound shaft is so great that it will be unnecessary to slow up the twelve-ton skips to be used, which will hoist at a speed of 3,000′ per minute. On the curved portion of the shaft its width is one foot greater than elsewhere, or 10′ 4″. The plans are to take out in from five to six years some 5,000 tons of ore in a day of 16 hours, the balance of the day to be used for mending of tools and repairs.

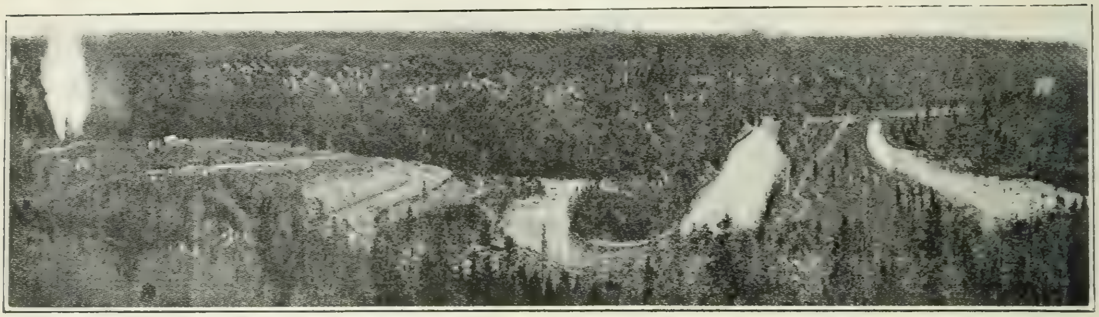
At present there is an eight-inch air line, but eventually there will be a ten-inch line for this property. There is expectation that this shaft will ultimately be driven down to 14,000 or 15,000 feet. The engineers are going ahead on this assumption as though it were an everyday matter.

Mr. Homer Guck, the interesting and energetic editor of the *Houghton Mining Gazette*, who is also an instructor in English at the Michigan School of Mines, gave the writer a dissertation at the Houghton Club one evening on some of the subjects of romantic interest in the region, beginning with the old Quincy mine, which was opened up in 1848. At the time of the Civil War this mine was the largest single copper producer in the United States. It was credited with having saved the Union and the cause of the North at a time when copper went to the highest price on record, 55 cents a pound. This was in July, 1864. Incidentally, just 30 years later the metal went to the lowest price on record, in June, 1894, when it sold at nine cents a pound.

The old power house of the Quincy is now handling 8,000 feet of wire rope on a hoist, but its new and fine power house, which we inspected, will handle 14,000 feet of cable on an incline shaft of from thirty-three and a third to twenty per cent. This working on the Pewabic lode differs from the idea of working on the C. & H., where on the conglomerate lode a shaft runs down vertically a mile to connect with incline shafts.

The general public seemed to have gained a notion that the Lake Superior Copper Country had been on its last legs, Mr. Guck observed, but this was an absurdity. A number of the mines had released a total of several thousand men, many of whom had gone into the automobile industry in the Lower Peninsula, but this lay-off was already regretted, and all of these men and more were wanted back on the Copper Range. The copper in the region is anything but "petered out" and the mines will produce for many years to come.

The old Quincy is still paying dividends and for 54 years it has never failed on a dividend. It began paying in 1862, and since 1868 has never



VIEW OF THE DAM, PART OF THE CANAL, THE COMPRESSOR HOUSE AND THE BLOW-OFF AT VICTORIA MINE.

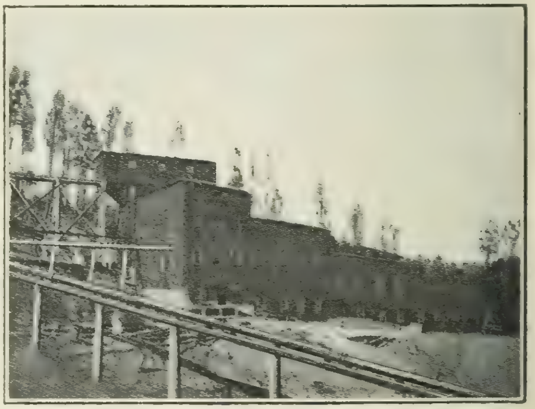
missed a year, there having been a total of 122 dividends, not includinig this year, aggregating $26,452,000. The mine has passed a few quarterly dividends, but never an entire year. And now, although 8,000 feet of incline shaft was formerly considered the limit for depth, the Quincy is promising to go to 14,000 feet—"without batting an eyelash," as Mr. Guck expressed it.

Copper mining conditions differ in Michigan from those of other copper districts inasmuch as the average production is only 16 pounds of copper to the ton of ore, the lowest percentage of copper for the tonnage in the world, but at the same time it is the world's highest grade copper. For the Michigan product the editor of the *Mining Gazette* suggested as the solution of a readier and wider market a great campaign of advertising by the C. & H. and other companies to show that the copper was worth more for certain purposes than other grades. And it is something of a battle to get that high grade copper to market.

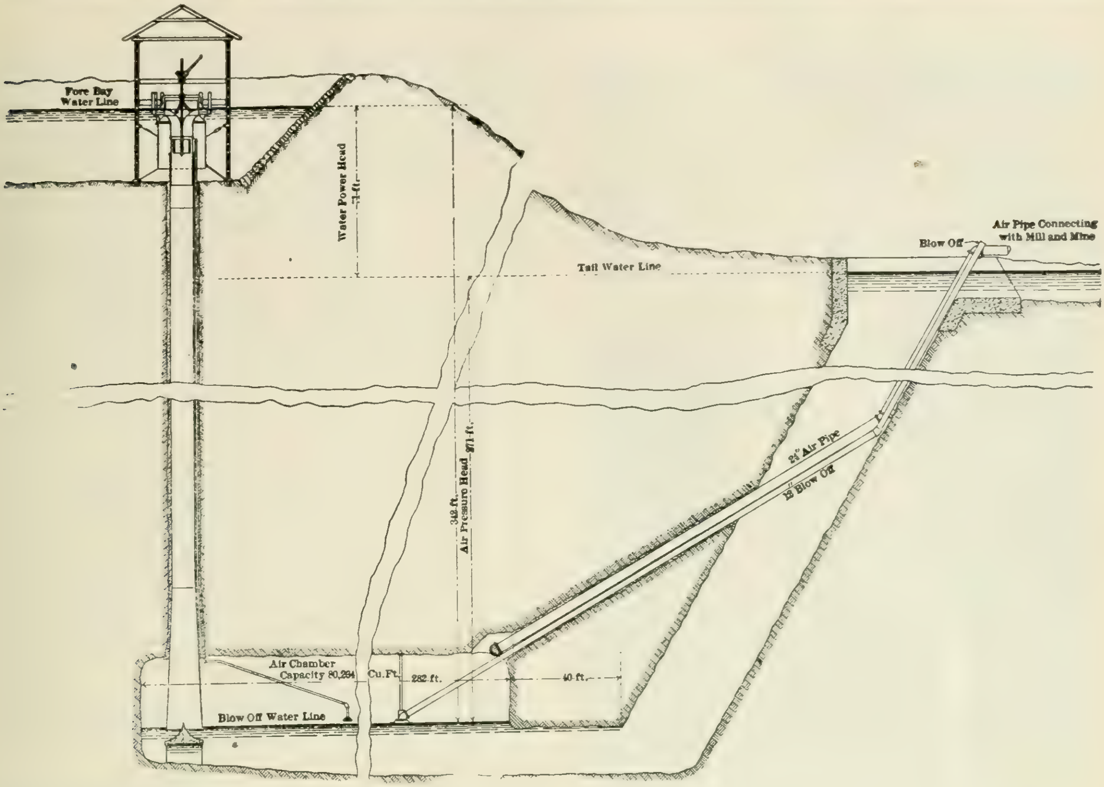
The operators go down a mile into the earth, then drift several thousand feet, in some cases drift a mile, then they drill their holes, blast down the rock, muck it and shovel it into cars, push the cars half a mile or so to the shaft, dump the cars into a skip, hoist the skip a mile to the surface, crush the rock in the shaft rock houses, drop the crushed rock into standard dump freight cars and railroad it all the way from six to fifteen miles to a stamp mill. At the stamp mill it is stamped, ground, tabled, washed, treated by oil or ammonia, and the resulting mineral is taken for another railroad trip to the smelter and converted into ingots. From the smelter the ingots are conveyed to pier and steamer and thence shipped down the chain of lakes to Buffalo whence they are railroaded to the Eastern seaboard. Despite the highest cost of production in the world and the lowest percentage of production to tonnage, this highest quality copper is sold at a profit. There is a world of patience, industry and engineering involved in this long process.

The Michigan copper men never say die! When the Anconda discovery was made thirty years ago and 140 pounds of copper was taken out to the ton, the C. & H. was taking out only 35 pounds to the ton. Many Michigan folk thought their copper operators might as well close up shop and some of the miners started west, but not the operators. They gritted their teeth and stuck with the big show. In a few years Montana was producing more copper than Michigan. Then along came the porphyry mines of Utah and Arizona, constituting another knock on the head for Michigan, but the operators clung to their mines and went ahead with production. Meantime the electrical industry in this country forged ahead with great leaps, just as it did in other countries, and Michigan's fine copper, best suited for electrical work, saw its market grow with its production. And by gum, say the operators, they are going to keep right on producing and selling to a world that knows good copper when it uses it!

Not all of the copper coming out of the district at present has such a high production cost, and there lies an interesting incident. To mine out



STAMP MILL OPERATED BY COMPRESSED AIR FROM HYDRAULIC COMPRESSOR.



VERTICAL SECTION SHOWING COMPLETE SYSTEM OF HYDRAULIC AIR COMPRESSOR.

copper costs about seventeen cents a pound, but the C. & H. is producing perfectly good copper at six cents. For four or five years they have been recovering old sand that formerly went over the jigs into the lake. Now they are dredging out about 640 tons a day of this sand, or tailings, recovering ten to twelve pounds of copper to the ton from what had escaped in a more careless and more affluent day.

More than a year after the beginning of the war, Mr. H. R. Leyden, an electrical engineer, made a report on a proposed Sturgeon River water power development, by means of which the idea has been to supply the greater number of the copper mines with considerably cheaper power for their hoists, compressors and other machinery, thus reducing operating costs, but to date this plan has not been put into effect. I read Mr. Leyden's interesting report of September, 1915, and also an earlier report of June, 1912, by Mr. H. P. Farrington, another electrical engineer who investigated the possibilities.

The day for electrical power throughout these properties, supplied from a common source, may yet come. At present power is supplied generally by low pressure steam turbines. At the Calumet & Hecla and Copper Range mills it is asserted that these installations, only recently made to provide power for regrinding "oversizes" and dredging up the tailings from the lake, give them at small increase in operating costs, sufficient additional power to operate the mills and a surplus to send back to the mines. Other mines have various steam plants, turbines and whatnot, with steam coal to provide at a high price, and the situation is that the heavy machinery at the mines, that is, the hoists and compressors, and pumps that pull water long distances, are operated by steam. The mine managers are agreed that they would like to have electric power throughout for their hoists and compressors, if it could be furnished at an advantageous price.

The serious problem is to supply electric power to special uses. The present steam equipment is very large and very expensive. To replace this by new electric driven machines would require a heavy investment, of course, and therefore a low rate for power to show much advantage. The very large drain on power in starting the hoists can only be overcome by a heavy outlay in special machinery if a direct application of electric motors is used. It would be possible, however ,according to the findings, for a power company to provide compressed air which would permit their present compressors to stand idle as a reserve and to operate the present hoists with air instead of steam, and this idea has been seriously considered. Mr. Leyden, in his report, regarded this as the most practical solution. However, this is a long and involved question of which we can make no more than this passing mention.

No article on this copper region would be adequate without a mention of the Michigan College of Mines at Houghton, which we visited with Professor Sperr, its mining professor, as a guide. This world-renowned school, which maintains exceedingly high standards, rejoices in a long list of alumni who have done things. The college records show graduates who are managers, consulting engineers, college professors and geologists in all the great mining regions of the world. The Transvaal, South America, Canada, Europe, Asia, Australia, all have sought engineering executives from this school. Among its alumni are high-salaried men now serving in such positions as the general manager of the Lancaster West Gold Mining Co. of the Transvaal; the general superintendent of the Calumet & Hecla mines in Michigan; the general superintendent of ore mines and quarries for the Republic Iron and Steel Co. in Alabama; the consulting engineer for the great Cerro de Pasco property in Peru; the manager of the International Smelting Co. of Utah, and scores of others in high place in the mining world. Alumni played a large part in the Great War and the college organized the first battalion of the 107th Engineers, more than 400 officers and men being furnished the A. E. F.

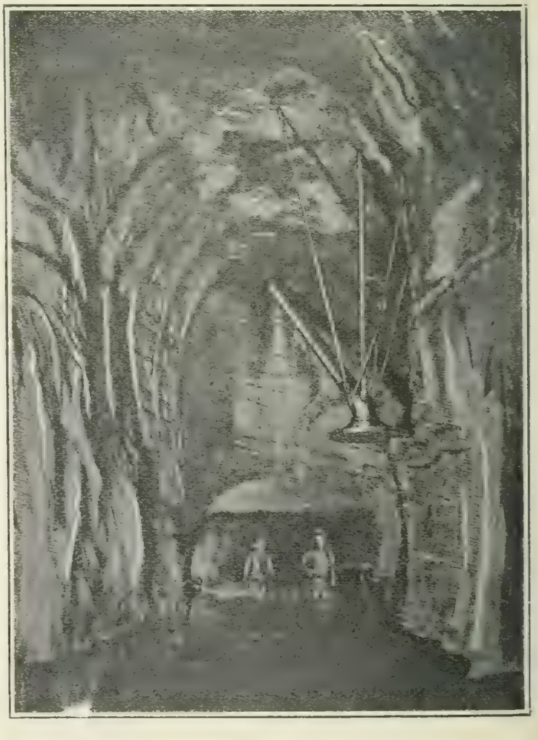
Mr. Herbert Hoover's chief assistant on the Commission for Relief in Belgium was Mr. W. L. Rennold, an alumnus of the college.

It is a small college, located in the city proud to be known as "the biggest little city in the United States." Residents have shown their town spirit and warm regard for the college by contributing liberally to build the gymnasium and clubhouse, in which building is centered the social and athletic life of the college.

The students have exceptional advantages in that they are made welcome in any of the 30 odd copper mines within trolley car distance of the college. Mines, smelters and power plants are open to them. Frequent underground journeys, conducted by instructors, form part of the practical training furnished by the school. The entire time in college is spent in an atmosphere of mining. Both the iron and copper districts of upper Michigan afford unusual opportunities for geological study and instruction. In winter the students enjoy typical northern sports such as skiing, ice skating, tobogganing and deer hunting, while in summer the men have as diversions, canoeing, trout fishing and swimming. The college operates on an all-year basis.

Before leaving the Copper Country and sailing away for Duluth and the iron country of Northern Minnesota, we had the opportunity of making a trip to the Victoria Mine, near Rockland, Mich., to see one of the most remarkable things found on our northwestern trip, the installation of the Taylor Hydraulic Air Compressor. Here we were greeted by Mr. George Hooper, general manager of the Victoria Mine, Mr. Thomas Hooper, superintendent, and by the chief engineer, Mr. E. R. Jones, the well known "Pike" Jones of the Michigan College of Mines, class of 1905, who explained and displayed the workings of this air compressing system to our party, comprising Mr. Knight of Houghton, Mr. A. F. Hahnel, now of the International Machinery organization, with headquarters in Chile, and the writer.

Why the movies have not discovered and photographed for the world this easily accessible and most spectacular mechanical wonder is a mystery. This installation, one of seven on the same principle in the world, is not new, having been constructed about fifteen years ago, and described at length in these columns in years past. For the layman and those unfamiliar with it, this hydraulic air-compressing system may be described as consisting of three intake vertical shafts five feet in diameter sunk to a depth of 330 feet un-



DISCHARGE END OF UNDERGROUND AIR CHAMBER SHOWING SUSPENDED END OF BLOW-OFF PIPE.

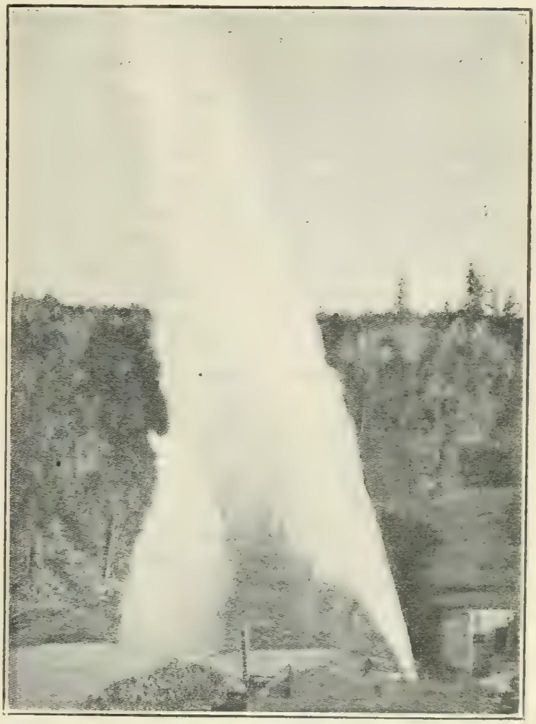
derground. Down these cemented tubes flows water of the Ontonagan River, curving over into the shafts at a depth of thirty inches. The shafts lead into an underground chamber into which the falling water sucks in and packs down the air to a pressure of 117 pounds to the square inch, or over 5,000 horse power provided from the compressor's free air capacity of 36,000 cubic feet of free air per minute.

A concrete dam 500 feet long and eighteen feet high crosses the river at a point 4,000 feet upstream from the compressor, and a canal having a cross sectional area of 350 square feet leads the dam to the forebay of the compressor, giving a working head of 71 feet. The shafts down which the water plunges on its long fall of twice the height of the American fall of Niagara, are cemented, leaving a smooth interior.

In the underground chamber is compressed the air by which all the machinery in the mine, including drills, hoists and the stamp mills are operated. When the machinery is shut down, the spectacular part of this equipment becomes apparent. As a safety valve there is a twelve-inch blowoff pipe that leads to the surface. The superintendent, Mr. Thomas Hooper, was kind enough to shut down the stamp mills for our benefit in daytime, so we could see the excitement from a safe point of vantage on the *leeward* side of the blowoff over the river bed down stream. After a wait of about a quarter of an hour, there was a roar and a rumble and a twelve-inch stream of water rose first slowly and then with a rush until it shot skyward to a height of 430 feet, finally spraying out in the wind until the water descended like a heavy rain. Many a spectator has been drenched to the skin when the wind's direction was either suddenly shifted, or else previously miscalculated, but we were fortunate.

We watched the spectacle spellbound for a half hour and then returned for dinner to the mine, looking back fascinated at the powerful stream of water as long as it was in sight. It was worth going hundreds of miles to see. In the dancing sunlight playing on the mist high in air three separate rainbows could be seen.

It is unnecessary to describe the details of the Taylor system, but in the case of this installation, which cost $22 per h. p. for outlay, it is worth noting that the cost of this power averages $2.25 per horse-power year, allowing five per cent. interest on first costs. It is a clever adaptation of an old air compressing method, but of course can only be adopted in a place where the physical conditions make it possible, which places are few and far apart. The pcitures will explain to the reader the Victoria installation. Any reader desiring a complete description of the installation may find it in the *Engineering and Mining Journal* of January 19, 1907, to which contemporary we are indebted for the pictures shown.


ARTIFICIAL GEYSER, OR BLOW-OFF, FROM HYDRAULIC AIR COMPRESSOR AT VICTORIA MINE.

"Pike" Jones drove with us that evening to Ontonagan, where on the shore of Superior we slept under triple blankets and rose before a chilly dawn to catch a four o'clock train back to Houghton.

The following Sunday night we sailed from Houghton for Duluth, going out to the big lake by the northwesterly channel from Portage Lake. As the steamer passed out by the light-house upon the chill waters of this inland ocean and we looked back, there stood out silhouetted against the sides of hills and mountains along the Copper Range, the buildings of shaft houses, mills and smelters, tall smokestacks pouring their black loads skyward in wreaths that spelled the finish of our visit to a land of fascination, and where at that evening hour thousands of men were toiling and sweating far underground. Long the passengers watched with the collars of their outer wraps turned up, until the scene faded in the dying rays of the sun.

NOTE.—Mr. Tietsort's next article on the Iron Country of Minnesota will appear in an early issue.—*The Editors.*

A New Industry—Making Fruit Butter Under Vacuum

By E. H. ROSEBERRY

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UNTIL WITHIN the last few years the demand for concentrated foods, such as evaporated vegetables and fruits, has been so slight in America that food packers have not felt called upon to give the subject serious attention. In most European countries, however, the advantages of evaporation in the preparation of food products have been recognized to such an extent that for years certain foods prepared in this manner have become articles of standard use.

It is only natural that immigrants coming into this country should bring with them a craving for the particular foodstuffs to which they have been accustomed. Their desires, in fact, created almost entirely what demand for foods of this kind existed in this country prior to the war. As these products were not obtainable here, they were imported from abroad. When hostilities began, however, importation immediately ceased. Then it was that the Italians, for instance, were deprived of their tomato products, such as tomato paste, and the American canner was urgently called upon to supply the need.

With the aid of the Italians themselves, suitable equipment was designed and built, and proper methods of production determined upon by experimentation, until within a year a paste of very best quality, retaining the rich red color of the natural tomato without the use of artificial adulterants was made and not only sold, but contracts were made for the next year's output.

Stimulated by their success with tomato products, manufacturers were encouraged to apply the principles of evaporation to the preparation of other products, such as fruit butters. Apricots, peaches, quinces, grapes and others were experimented on, each in turn, until it was conclusively demonstrated that appetizing butters from fruits could be made.

Our following brief discussion deals with the manufacture of apricot butter at the Hemet (California) plant of the California Growers' Association and the process described can be considered typical of the method of manufacture of all fruit butters, with slight exceptions, as practiced by that company, which is a pioneer in this industry.

As indicated by the accompanying plant flow-sheet, (Fig. 1) the fruit from the orchards is first graded, the normal-sized fruit being used for the usual canning purposes, while the under-sized fruit and fruit that is a little too ripe for the usual canning process is first carefully sorted, then washed, crushed, and pitted in suitable machines, and then conveyed to machines called finishers where the skins and fibre are removed. The skins and fibre are wasted, but the pits are shelled and blanched and the kernels are used to make massage creams, oils, candy adulterants and similar products. With the exception, possibly, of the pitting machines, all of the apparatus referred to is standard cannery machinery.

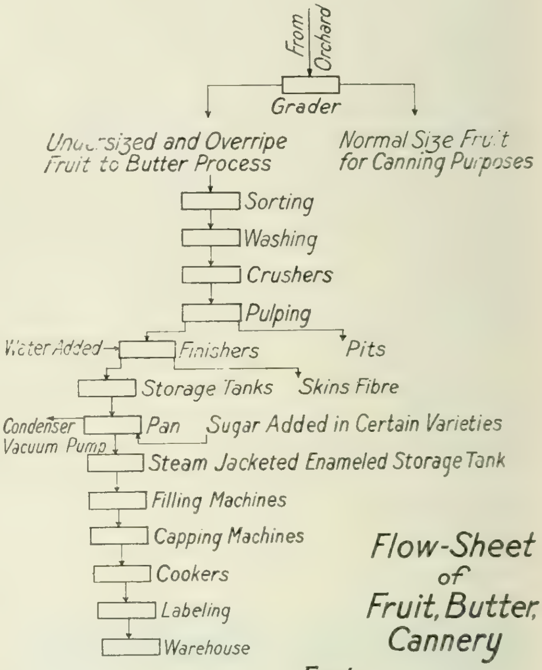

From Orchard
Grader
Undersized and Overripe Fruit to Butter Process
Normal Size Fruit for Canning Purposes
Sorting
Washing
Crushers
Pulping
Water Added
Finishers
Pits
Storage Tanks
Skins Fibre
Condenser Vacuum Pump
Pan
Sugar Added in Certain Varieties
Steam Jacketed Enameled Storage Tank
Filling Machines
Capping Machines
Cookers
Labeling
Warehouse
Flow-Sheet of Fruit, Butter, Cannery

FIG. 1

The pulp leaving the finishing machine is now diluted with water so that it can be pumped by centrifugal pumps into storage tanks. The percentage of moisture after dilution is about 90%, but much of this is made up by the natural fruit juices, practically all of which is caught and retained in the course of the various crushing processes.

The storage tanks are usually situated slightly above the vacuum pan and generally are several times the capacity of the pan itself. Thus the latter can be filled, either with, or without the vacuum on the pan.

As the pulp is introduced into the evaporator sugar for sweetening is added when making apricot butter, but not all products require this sweetening.

It is in connection with the evaporator system that special attention is called. Quality, of course, for the finished product is always desired, but the rate of production is a very important factor. Early experiments were made on open kettles heated with steam coils or jackets, but two important objections prevented any extensive use of the open type of kettle. One of these is the high temperature at which boiling takes place at atmospheric pressure, which fact frequently causes the product to lose its natural color through oxidation, and the second is the length of time required to evaporate a given quantity of moisture. The vacuum pan quickly found favor and several types were built.

One of the most successful pans is spherical in shape, (Fig. 2) steam-jacketed, and built of acid resisting material such as bronze and copper with a steam coil arranged with stuffing boxes where the coil enters through the shell of the pan so that this coil can rotate and act as an agitator in addition to heating the contents of the pan. Fibre brushes attached to the coils which revolve at the rate of about ten revolutions per minute automatically scrape the bottom of the pan, thus preventing the formation of a crust which would result in burning.

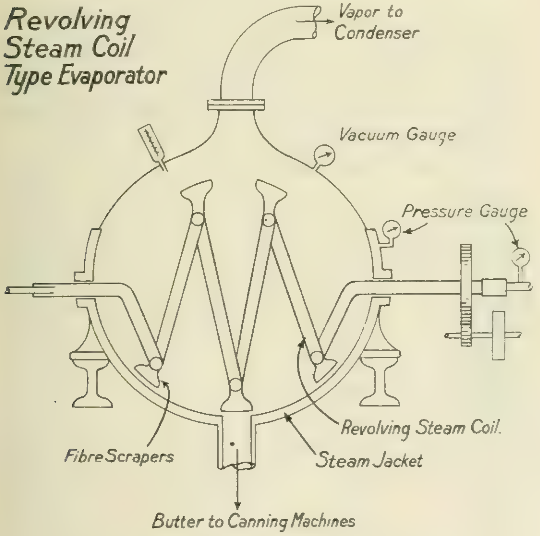


Fig. 2

Another type of pan is made of glass-lined steel with stationary coils, one or more of which can be put in service as the required rate of boiling varies. (Fig. 3).

The sketches indicate the principle involved in each pan.

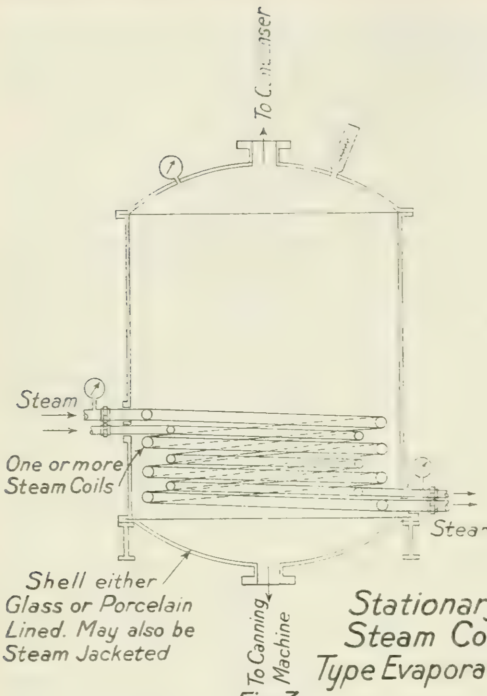
The spherical type referred to (Fig. 2) is used at Hemet. This pan will take a charge of 600 gallons of pulp, which, with a vacuum of 27"-28" will evaporate down to about 300 gallons, or 50% in approximately 1¼ hours. This is equivalent to an evaporation of about 2400 lbs. of liquor per hour. It is claimed that the evaporator will handle practically twice as much water per hour under similar operating conditions. Steam pressure at about 80 lb. is usually available, but this is throttled at the evaporator coils to suit boiling requirements.

The condensing equipment used consists of a size No. 5 steel plate Beyer counter current barometric condenser fitted with a patented moisture separator for drying the air and non-condensable gases before removal by the vacuum pump. The vacuum pump is a Class "ER-1" high speed dry type, 22" diameter by 8" stroke and is driven by a 25 h.p. motor through a short belt drive attachment. Both the condenser and the vacuum pump were furnished by the Ingersoll-Rand Company. They are of such size that several additional evaporators can be served as the plant requirements increase. With this equipment a vacuum of 27-28" mercury is maintained with cooling water available at 70°-80° Fah., using an average of four gallons cooling water per pound of steam condensed.

To guard against loss by entrainment, in case of accidental boiling over of the pan, the vapor pipe is constructed with a bend, as shown by the drawings. A drain from this bend back into the pan was used to recover the liquid entrapped in the vapor pipe.

Ordinarily, this construction of vapor pipe is to be avoided, as, should the valve in the drain pipe be left closed, or the drain pipe be choked up with pulp, the trap immediately becomes inoperative and impaired vacuum may result. It is better in cases of this kind to eliminate the bend entirely, carrying the vapor pipe directly to the condenser. If entrainment still occurs, increased vapor liberating space must be provided, if necessary reconstructing the pan, or the rate of boiling must be decreased.

After the liquor is evaporated to the desired consistency, as found from samples taken during the course of evaporation, the vacuum is broken by means of a vent, and the mass now weighing about 12 oz. per gallon heavier than water is dropped by gravity into steam jacketed enameled tanks where it is maintained at the heat at which it is expelled from the pan, then passed to filler and capper machines where it is packed in tin cans. These cans are next tested for leaks, then conveyed to standard cookers, where their con-


To Condenser
Steam
One or more Steam Coils
Steam
Shell either Glass or Porcelain Lined. May also be Steam Jacketed
To Canning Machine

Stationary Steam Coil Type Evaporator

Fig. 3

tents are sterilized at a temperature of 200° F., and finally are labeled and packed for shipment.

Butters from other fruits mentioned are made in a similar manner to that described for apricots. The general process employed differs chiefly in the time required for concentration to the required consistency.

In all probability still other fruits will be experimented with, for evaported foodstuffs of this kind have a value which is only indicated by the following more important reasons:

(*a*) Concentrated fruits cost less than fruits as ordinarily canned. Probably the chief reason for this is the nature of the ingredients used. Ordinarily, canning fruit is normal, or large sized, and of good quality. Fruit for butters can be under-sized, or slightly over-ripe, although only good quality is used, free from adulterants. Again, because of the concentrated nature of the product, freight rates to distribution points are materially reduced, thereby having no small effect in fixing low net selling prices. In the case of apricots, for instance, a 12 oz. can of butter is equivalent to about three pints, or about three pounds of the canned fruit, yet the same 12 oz. can sells for very little more than a pint can of the canned fruit.

(*b*) The development of this industry is an important step in food conservation. Formerly, part of the fruit not actually canned was dried and put on the market in that form, but much that now can be used was considered unsalable and was accordingly wasted.

For the present, the preparation of canned fruits as ordinarily practiced will undoubtedly continue unabated. As fruit butters become more generally introduced, however, it is felt that this new industry will grow rapidly, particularly when the consumer realizes that he is absolutely protected by strict government inspection against the use of improper ingredients, or by other means that would make for any but a strictly pure article.

Pioneers in this line, therefore, look forward to a big demand for their products. In fact, it is very gratifying to them to have their products so well received that this year's total output already has been contracted for and only their limited means of production prevents them from marketing considerable more.

AIR MACHINERY EXPORTS

The Division of Statistics of the Bureau of Foreign and Domestic Commerce, Department of Commerce, furnishes the following figures on United States exports of air compressing machinery for the month of June, 1919:

Countries	*Dollars*
Belgium	15,257
France	128,971
Italy	79,415
Netherlands	5,892
Norway	4,709
Russia in Europe	6,750
Spain	74,644
Sweden	1,446
England	43,401
Scotland	1,441
Canada	40,405
Costa Rica	18
Panama	1,166
Mexico	12,373
Miquelon, Langley, etc.	1,000
Newfoundland and Labrador	112
Cuba	20,419
Dominican Republic	90
Argentina	10,891
Brazil	20,141
Chile	2,497
Peru	857
Uruguay	700
Venezuela	2,250
China	323
British India	5,018
Dutch East Indies	3,175
French East Indies	7,341
Japan	68,992
Australia	5,593
New Zealand	450
Philippine Islands	6,731
British South Africa	3,270
Portuguese Africa	132
Total	$575,870

It is announced from Buenos Aires that the All America Cables system controlled by the Western Union Telegraph Co. has completed the laying of its new cable in the River Plate. This will connect New York with Montevideo via the cable extending through Colon. The new cable is now in operation.

How a Great Export Trading House Handles Machinery Sales

By GEORGE H. COE

The operations of the great house of Messrs. W. R. Grace & Co., which typify American enterprise in many parts of the world, include the handling of many lines of intricate and expensive machinery for their clients. Each year the Grace organization exports for American manufacturers millions of dollars' worth of machinery equipment, machinery that enables other countries to produce outputs for their own home consumption and also for exportation to us, enabling them to pay for what they buy, in the ordinary workings of economic laws. In the current issue of the "Grace Log," the ably edited house journal of the company, there appears the subjoined article on the subject, which we are permitted by their courtesy, to reproduce. The company does a brisk business in air compressing machinery, drills, tools and other pneumatic equipment. THE EDITORS.

W. R. GRACE & CO. started in the machinery business in 1886, although for many years previously they had been handling machinery indents for clients. The development of the machinery business was confined exclusively to the West Coast of South America, and therefore followed the lines of development peculiar to that territory.

The tendency to change from primitive methods in agricultural, mining and other activities, naturally brought the first development of machinery into the lines of frontier equipment, such as log mills and saw mills, and agricultural equipment for harvesting and preparing the product.

No facilities were available to the people of South America for securing local information as to the equipment they required, nor for obtaining such equipment. Consequently, machinery of this class was brought in only as specified by local proprietors who had perhaps visited countries further developed, or from the reading of agricultural papers or advertisements.

In the year 1886, the Chilean Government recognized the necessity of having improved agricultural equipment, and in order to bring such equipment to the attention of their people, held an exhibition in Santiago where many manufacturers displayed their machinery.

At that time W. R. Grace & Co. decided to go into the machinery business in Chile with the agency of the J. I. Case Threshing Machine Company for grain threshers and portable engines; the McCormick Harvester Company for reapers, binders, mowers and rakes, later adding stump pullers, hay presses, log mills, flour milling equipment, wood working machinery, and finally modern riding plows.

This machinery business was carried on in Chile in a specialized and highly organized manner, and contributed largely to the wonderful agricultural development in that country. Other lines of machinery were not handled except in a hit or miss way on a commission basis, until 1900 when, due to the Grace interest in the proposed electrical development at Lima, Peru, it was decided to take up the sale of electrical apparatus, and in 1902 an exclusive sales agency arrangement was made with the General Electric Company covering Peru, Bolivia and Chile.

A sales engineer from the General Electric Company was placed with the organization on the West Coast of South America to advise prospective customers as to their requirements in these lines, and to supply technical information and service on the equipment. Within a year it was found that one sales engineer was not sufficient and another General Electric man was engaged so that one could be permanently located in Chile and the other in Peru. During the next two years it was found that the handling of electrical apparatus involved other classes of machinery such as water wheels, steam engines, boilers, pumps, hoists and general mining equipment, and agencies covering these lines were taken on and other technical experts added to the organization.

In 1907 the machinery business was extended to cover the nitrate district with technical organizations at Iquique and Antofagasta; also into the mining districts of Bolivia with technical organization at La Paz. A technical department was established in New York to co-ordinate the operations of the various branches, and supply the services necessary for their operation. Messrs. Grace Brothers & Co. also added a technical staff to their organization in London, while the New York House supplied the machinery branches with information on machinery from England or the Continent, and selling to the various purchasing offices in London.

From 1907 to 1912 the growth of the machinery business was rapid, and in 1912 it was decided to separate this business in Chile, and the International Machinery Company was formed. All of the machinery lines outside of the agricultural machinery were turned over to the International Machinery Company, with jurisdiction over Chile and Bolivia. The formation of the International Machinery Company enabled our machinery business to still further expand, especially in merchandising lines, and a large business developed in electric motors and supplies, and general mechanical supplies distributed from stock.

Practically all of the machinery on the West Coast of South America has been supplied from the United States, Great Britain or Germany. At the start the United States had the lead on electrical plants, agricultural machinery, railroad equipment, and possibly on primitive sugar machinery; whereas England predominated in general industrial machinery, engines, boilers, pumps, hoist machine eools, etc. As time passed the United States began to get a share of the general machinery business, Germany a share of the electrical business, and England an increasing proportion of railroad equipment due to the British Railroads. The year 1914 found Germany securing the bulk of the electrical apparatus and equipment, especially in Chile; England having most of the business in sugar machinery, and the United States gaining a larger part of the general industrial machinery, the equipment for railroads being supplied principally from England and the United States.

At this time Brazil was almost exclusively supplied with machinery from Germany, except railroad equipment which was principally English; whereas in the Argentine the United States supplied the bulk of the agricultural machinery; England the bulk of the general industrial machinery and most of the railroad equipment; and Germany almost all of the electrical and power plant equipment.

Consideration had been given by W. R. Grace & Co. to expanding the machinery business to the East Coast, but this was not considered practical until the German supply had been shut off in these markets. Therefore, in the latter part of 1916 a railway supply salesman was dispatched to Brazil to solicit business from the railways there, and in May, 1917, the International Machinery Company was opened at Rio de Janeiro to take care of the general machinery business in Brazil. One year later the International Machinery Company was opened at Buenos Aires, so that the Grace machinery business is now well established in all parts of South America.

In the latter part of 1916 a machinery department was established at Barcelona, Spain, and while war conditions held up the development of this territory, it is now increasing its activities.

Within the last year it was decided to engage in the machinery business in India, and on June 27th, of this year, Grace Bros. India Ltd., put into operation the British American Machinery Company, Calcutta.

In general the machinery organizations are handling all lines of machinery used in the various markets, but some of the more recently established organizations are concentrating on certain lines only. On the West Coast of South America the principal lines are those of the General Electric Company, and the Ingersoll-Rand Company, with an important movement in sugar machinery, textile machinery, railroad equipment and supplies, mining machinery, and power plant equipment. In Brazil and the Argentine the principal items are sugar machinery, textile machinery, railroad equipment and supplies, machine tools and woodworking machinery. In Spain the lines so far developed consist principally of machine tools and small mechanical tools.

The Grace machinery organization has supplied equipment for many important installations leading to the development of the countries in which they are installed; the Empresas Electricas Asociadas at Lima comprises two hydro electric stations, one steam generating and distributing station, four railway sub-stations; also a tramway system of several interurban and urban lines covering about 73 kilometers of track; equipment for the electric tramway at Arequipa, Peru; the material for the construction and equipment of the steam railway from La Paz to Oruro; the material for the construction and equipment of the electric railway from the Alto in La Paz down to the city; the designing, supplying of material, and construction of the Oficina Paposo, having a capacity of 4,000 quintals of nitrate per day; the construction of the electric railway and power plant of the Bethlehem Chile Iron Mines Company at Cruz Grande, Chile; the complete equipment and construction of the Concepcion Electric Company at Concepcion, including the interurban lines from Talcohuano; the electric equipment for the electric railway from Santiago, Chile, to San Bernardino; in Argentina, for the Compania Hilanderia de Argentina, the complete machinery for a cotton mill having 2,760 spinning spindles and 1,120 twister spindles; for the Compania Azucarera, Concepcion, a new 14-roller sugar mill having a grinding capacity of 1,800 tons of cane per day. In Brazil, for C. Rios & Co., Uzina Terra Nova, a sugar mill of 11 rollers having a grinding capacity of 700 tons of cane per day, and complete new equipment for boiler house; for A. Soveral & Co., Uzina Colonia, a 3-roller sugar mill of 350 tons grinding capacity, and complete equipment for boiler house.

Australia is going in for more shipbuilding at home. The Government is asking for proposals for the construction in Australia of four steamships of 10,000 tons each. The plans prepared call for vessels 450 feet in length, of 56-foot beam, with 150,000 cubic feet of space for refrigerated cargo, and for a speed of 12¾ knots per hour.

The Future of the American Merchant Marine

By J. A. KISSICK
Assistant to President, Chester Shipbuilding Co., Ltd., and Comptroller, Lake Torpedo Boat Co.

"Our opportunity is here today to build up a great merchant marine, to carry American goods once more in American ships to all parts and ports of the world."

THE HISTORY of American ship-building and shipping from colonial days has been characterized by successive periods of progress, brilliant achievement, decline and partial recovery.

The causes for this varied history are themselves various: some economic, some competitive, some the result of natural forces—the presence of great forests of timber on this continent at a time when all ships were built of wood; the rise of the steel industry in a competing nation at a time when steel was beginning to displace wood on the ocean; wars; the payment by others of greater subsidies than this country was willing to pay. Competing ships of another flag; lack in this country at a critical period of an intelligent public opinion to stand behind the merchant marine, and latest, a great emergency which put Americans on their mettle as no other event has ever done—all have played their opposing part in the story at one time or another.

One notable period in our history stands out above all others; the time preceding the Civil War, when we commanded the sea by building ships of better model, manned by more efficient sailor-men who earned better wages than any one else would pay, and by the lead taken in mcehanical devices for speeding the loading and unloading of cargoes. Merchants and traders in this period all over the world paid higher rates for shipments in American ships, and paid them cheerfully, because the swifter, better service was worth it.

That was almost a perfect example of the progressiveness upon which Americans pride themselves. We may now call attention to the elements that entered into it and made for success. It is no mere coincidence that these same general elements of the situation are facing us today, and calling upon us to show whether or not American progressiveness and initiative are still with us.

But—just as American progressiveness, without the support of a strong public opinion and a wideawake Government, did not save the American merchant marine in the crisis of the Civil War, when the Confederate cruisers were sinking American ships in every sea, so likewise we cannot succeed in our present effort if American initiative and progressiveness are not fully supported in every way possible to meet the advantages which foreign nations, in one way or another, lend to their merchant marine.

J. A. KISSICK

Our opportunity is here today to build up a great merchant marine, to carry American goods once more in American ships to all parts and ports of the world, and it is a time in which we can all help in the formulation of the right policy, at least, by electing or supporting for office those who will work and plan loyally for the development and maintenance of such a fleet as will fulfill our high hopes.

For the construction, maintenance and continued success of an American merchant marine, we must have—in some cases we already have, or are soon to have—

(1) A large, successful and continuing shipbuilding industry, intelligently safeguarded and attaining a high degree of efficiency through progrissive and standardized methods, backed by the loyal coöperation of a well-paid and contented army of labor, and by substantial and direct Government support if, and as long as it is necessary.

(2) Organizations operating and conserving

ships on a plane of efficiency high enough to compete successfully with those of other nations as proposed in general by the United States Shipping Board.

(3) A well-worked-out plan for the development of our port, terminal and storage facilities on the most modern scale, so that we may again lead the world in safe, speedy and economical handling of cargoes, and may, through reducing the "turn-around," keep our fleet of ships going at their best speed.

(4) Banks and bankers willing and able to provide the funds necessary for financing, on the broadest scale, not only shipping, but the entire structure of export and import trade. This includes the establishment of branches of leading American banks in foreign countries, such as is already, in some cases, under way.

(5) Legal authority for firms and individuals engaging in foreign trade to combine for their mutual advantage for greater efficiency and economy of operation. This has already been given under the Webb Act.

(6) A broad education of our manufacturers and merchants of every kind in the possibilities and requirements of successful overseas trading.

(7) The building up of a well-balanced trade by increasing our imports of commodities, for manufacture, re-export or home consumption. We cannot sell to all the world without being willing also to buy and our ships need cargoes homeward as well as on the outward voyage.

These may all be reduced to six fundamentals: (a) markets, foreign and domestic; (b) cargo movements to and from ships; (c) movement of ships with cargo or without; (d) financing; (e) legislation; (f) a broad general policy of construction development.

But without ships, the other five fundamentals are at the mercy of the foreign nations who possess them, and they thereby fall heir to the trade opportunities we surrender.

To give up the best of our ships and shipping to foreigners, and to rest content with such service as they may see fit to supply, would be almost as bad as though we sold our railroads to foreigners, or permitted them to send over their equipment to operate on the lines we had built for ourselves.

The ship problem has been under study since the war started in 1914, and especially since 1917 when we came into it just at the height of the enormous destruction by German submarines.

Mr. E. N. Hurley, the lately resigned chairman of the United States Shipping Board, has several times published reports and statements giving the official view of the United States Government on the situation and some of his figures are interesting.

At the outbreak of the war, for instance, the total steam sea-going merchant tonnage of the world (exclusive of Germany, Austria and Turkey) was 34,924,000 gross tons. After four years of submarine and mine destruction, captures and ordinary and extraordinary accidents of the sea, 15,218,000 tons of this had been lost.

But in this time 11,856,000 tons had been built in the shipyards of neutrals, Great Britain, France, Japan and the United States, Canada and Australia, and 2,393,000 tons captured from the enemy, so that at the end of the war the Allied and neutral merchant fleets still stood at 33,956,000 tons. But while at the beginning of the war the United States possessed only 1,758,465 tons of the greater total, at its close, owing to its captures of German ships, and the wonderful output of its shipyards, it possessed 5,231,473 tons, and to-day stands as "potentially the greatest maritime power of the earth, for the reason that we possess the greatest shipbuilding instrumentalities."

What are we to do with this great fleet of the present, to say nothing of the potentially far greater fleet of the future? In a later address, Mr. Hurley sums up the possible policies as follows:—

(1) Government ownership and operation.

(2) Government ownership and operation through the medium of a private corporation, similar to the Emergency Fleet Corporation.

(3) Government ownership and private operation for Government account, the private operator acting merely as agent for the Government.

(4) Government ownership and private operation for private account; the ships being chartered or leased to private firms at a fixed rental.

(5) Ownership by a single enormous, but private corporation.

(6) Private ownership and operation on the basis of unrestricted private enterprise.

Which is to prevail? Mr. Hurley has unreservedly advocated the return to private enterprise, holding that only with the greatest degree of freedom and incentive for American individuality and initiative, can the problems which still lie before us be brought to a solution.

Such expressions of opinion as have come from tries, show plainly that in overwhelming majority, they agree with Mr. Hurley, and that the industries are fully conscious of the responsibility which, by adopting that solution, they will be assuming toward the entire people of the United States, whose interest in this great problem is peramount.

Much remains to be done, hopeful as the prospect is. Foreign trade and shipping must, hereafter, be more than the interest of the banker and capitalist, or the manufacturer looking for new markets. They must become the intimate concern of every American, who must learn, once and for all, that in the foreign trade of his country is bound up the well-being of his country, and that the well-being of his country means, in the long run, his own success and welfare.

BUREAU OF MINES DEDICATION

Just as these words are scheduled to greet our readers the new Pittsburgh laboratories of the Bureau of Mines, which have cost more than a million of dollars, are being dedicated with elaborate ceremonies in which prominent representatives of the mining and metallurgical industries very properly participate.

The dedication ceremonies, commencing Monday, Sept. 29, bring to Pittsburgh for the three days the most important mining and metallurgical men of the nation, and an elaborate programme of events has been prepared which includes the presence of high national and state government officials.

It is not permissible, through lack of space, to rehearse here the programme in detail, but attention may be called to the most prominent and specialized feature, the mine rescue and first aid exhibits and contests.

The formal and elaborate ceremony of dedication occurs on the beautiful lawn in rear of the laboratories, Dr. Van H. Manning, Director of the Bureau, presiding. After the invocation by Dr. S. B. McCormick, Chancellor of the University of Pennsylvania, comes the address of welcome by Hon. E. V. Babcock, Mayor of Pittsburgh, and response by Hon. Franklin H. Lane, Secretary of the Interior, followed by addresses and then the formal ceremony of handing over the keys of the building by Secretary Lane to Director Manning.

Then after luncheon a special train takes the guests to the Experimental Mine at Bruceton, Pa., and there a pre-arranged explosion of coal dust takes place as a demonstration to the visitors and after that comes an inspection of the mine and the explosives testing plant.

In the evening, after the return from the mine, there is a general meeting at Carnegie Music Hall under the auspices of the Pittsburgh Chamber of Commerce, with an address by Secretary Lane, an organ recital, and the first showing of a new moving picture, "The Story of Coal."

All this and much more, in the way of luncheons and things, on the first day. On Tuesday come the elimination contests in the National Safety First-Aid Meet and the awarding of State championships, then a demonstration of the explosibility of coal dust and at night the Chamber of Commerce presents a pageant typifying the spirit of the mining industry, with music by the band of the Carnegie Institute of Technology.

On the last day occur various contests, another great coal dust explosion and a smoker at the Chamber of Commerce in which prizes will be awarded and various speeches made.

The Laboratories surely get a good send off.

Air Machine at Polytechnic School

The Benson Polytechnic Institute of Portland, Oregon, a combination of technical and trades school, has a rather complete machine shop and foundry for the use of its students. The students have the benefit of the installation of a class "FR" compressor, 9x9x8, built by the Ingersoll-Rand Co. This machine supplies compressed air for the machine shop and foundry and has been found of great value for demonstration purposes. A large number of technical schools throughout the country have purchased air compressing equipment, having found it indispensable in their mechanical engineering courses.

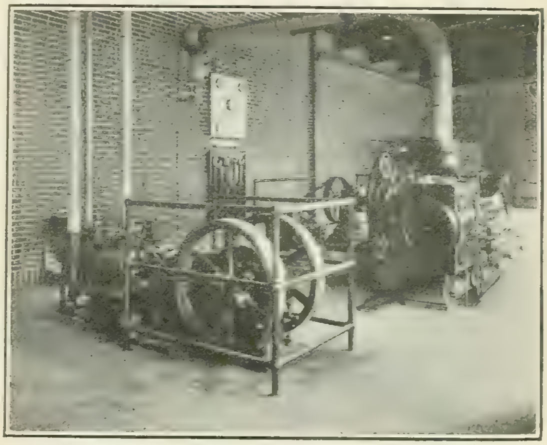


Photo by Courtesy Benson Polytechnic Institute.

Harry M. Giles has been appointed general superintendent of the South Philadelphia Works of the Westinghouse Electric & Manufacturing Company. Mr. Giles, who succeeds the late Oscar Otto, killed recently in an automobile accident, has risen from the ranks in the Westinghouse organization. For a number of years he was superintendent of marine erection, a position to which he was appointed by H. T. Herr, when the electric company absorbed the machine company.

Survey of the Technical Field

Edited by FRANK RICHARDS

KEEPING MACHINES IN CONDITION FOR THE SHARP STEELS[*]

CONSIDERING the amount of steel which has been sharpened by writers in mining papers in the last year, there should be a large percentage of the drills in good condition. This being the case, would it not be a good idea to repair a few machines, and get them in condition to use this sharp steel?

The ability to take a pencil and figure out how deep a drill will penetrate the rock at each blow is not mine. From the time I used air drills on which the chuck wrench was nearly as heavy as the up-to-date machines, to the present, I have been kept busy trying to make the boss pull out a little more tape line each month and use a little less powder to pull the ground. So I have had no time to get down to 1-16 and 1-32 in. for each blow. The dark, deepcut holes that would break were of more interest to the employer.

Writers on the subject never mention whether the tests have been made in a snow bank or in boulder granite, and consequently it is hard for a miner to tell whether he is keeping up to date or not. If the bit penetrates the rock 1-16 in. at each blow, as some say it will, then the old timer will have to go, together with the piston drill, to the junk pile; as eight blows should clear the hole to *that depth,* 1200 blows a minute, well—pretty fast. The slides on the shell would begin to warm, and a motor would be needed on the feed screw.

No good drill man will use dull steel when he can get sharp steel, but there are times when it is necessary to fight a hole with dull steel for a few inches, when the steel is cut up into different lengths. In the shop, as a rule, drills are so made that one steel has to be run out before the next one will take hold. Should the gage become worn and the bit dull, on a starter or second before it is run in full length, one of the same kind will not go into the hole, as it is too large. The longer one will not go because there is not room; hence the dull one must be run out. This often happens in hard ground.

Many drill men are better off with dull steel than with sharp, as they cannot drill as deep holes with the dull steel, and consequently cannot get as much powder in them to waste. They put their holes in the easiest and most convenient place they can find, caring little how much ground they pull. All they are there for is to get in the shift. The question of footage never enters their gray matter.

MACHINES MUST BE IN GOOD CONDITION

There is no doubt that sharp steel is better than dull; but, if the machine has not the "kick," the work will not be up to the standard, regardless of the drills. The managers and superintendents of most mines give little or no attention to keeping the air drills in proper condition. They have the impression that as long as a machine will run it is all right, provided there are sharp drills.

In many mines the following conditions or similar ones prevail: A drill runner goes to his place of work when he goes on shift. In due time he gets a steel in the chuck and is ready to drill. He opens the throttle. The hammer may not strike a blow, or it may not hit with any force. The night shift has done something to it. The drill man on shift takes a monkey or Stillson wrench and goes after it. In taking it apart he loses the pawl plungers. The pawl springs look bad; the pawls are worn and the rifle bar is in bad condition. After a search for a cager or nipper, he sends for the parts, which *he thinks* the machine needs. By the time he gets the drill working again, from two to four hours of the shift are gone. No drilling has been done, and $10 worth of new parts have been used. In this case a sharp bit will accomplish no more than a dull one.

Another drill man finds himself in the same condition, but not being of a mechanical turn of mind he looks for another machine, and, if lucky enough to get one, sends his own on top. It eventually gets to the blacksmith shop, where it is thrown in the dirt until the blacksmith, his helper, or possibly some surface employee has time to work on it. It is put in the vise or, more often lies on the floor while being repaired. It is taken apart, cleaned and put together with a few new parts from the storeroom—always new parts—at an expense of from $1 to $30, and the old parts are thrown on the junk pile.

Is this drill in good condition when it is returned to the mine? No one knows. There is no way of testing it in the shop. When the drill runner gets it he knows whether it has a good "kick" and if it rotates properly, but he knows nothing about the amount of air used to operate it. The air may be leaking through some part of the drill, or the valve may not be cutting off properly.

The idea that an air drill is "fool proof," and that any person on the job can repair it, is a mistake. A drill must be cared for properly, as well as any other piece of machinery. No matter how good the operator, it needs overhauling at certain intervals, in a shop fitted for that purpose and provided with a meter for testing the amount of air used. When a compressor making 2000 cu. ft. of air a minute has to be run at maximum speed to furnish air to a number of drills which, if in good condition, would use only 1500 cu.ft., there is something wrong. In most cases it will be found in the air drill.

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[*] *Harry E. Scott, Johnson, Arizona, in Eng. and Mining Journal*

AIR DRILL REPAIR MAN

The air drill repair man, or machine doctor, as he is often called, is an important factor. The best repair men are those who have had a few years' experience running machines, and who are handy with tools and mechanically inclined. They know from experience the work to be done, and realize the troubles of the runner, which are many. A man of this kind who had become familiar with the cost of drill parts, and learned to throw nothing away that could be worked over and give efficient service, took a job. During the first 10 days he picked up over $900 worth of drill parts from the dump and junk-pile. These were used, and gave as good results as new parts from the storeroom would have done. They had been thrown away by the man who was repairing drills; and it had taken him only a short time to do it, and with only 16 machines on the job!

Any property using a small number of air drills can support a good repair man—one who can keep the drilling speed up (with sharp steel) and the maintenance cost down. With the machines in good condition, sharp steel, plenty of air and the right man on the crank, there should be no kick from the office concerning the number of feet drilled.

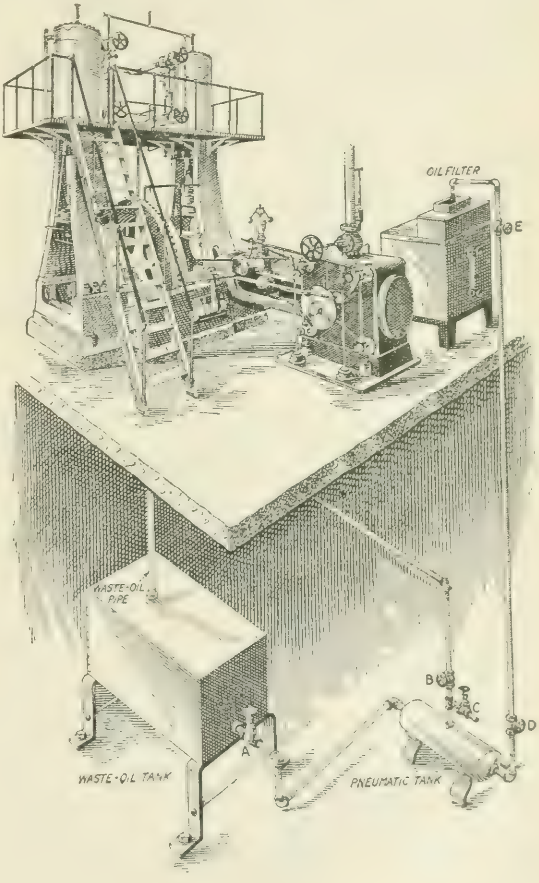
PLAN TO AID MINING SCHOOLS

A bill was recently introduced into the United States Senate providing for the expenditure of $25,000 per year in each State to aid mining schools, the money coming from sales of public lands. The equal opportionment to each of the states may not seem most wise or profitable, but it seems to be the only arrangement possible to put through. The government aid will be "for instruction, research and experiment in mining machinery, mining engineering and treatment, metallurgy, assaying, chemistry and geology."

One of the principal aims of the bill is to study the prevention of explosions, fires, etc., and to promote the general welfare of miners and operators. For the scheme as outlined the appropriation is so absurdly inadequate as to be utterly worthless, but somebody may get the money.

ENGINE ROOM EQUIPMENT FOR HANDLING OIL

The cut here reproduced from a recent issue of *Power* shows, with a clearness which renders description superfluous, an easy and cleanly means of handling the otherwise waste oil from steam engines and other machines. It was installed by the writer (C. J. Domville, Port Hawksburg, N. S.), and handles all the oil from four engines and two refrigerating.



The oil is conducted by suitable drains to a galvanized-iron tank in the basement, from which it is drawn through the valve *A* into the pneumatic tank, which is a 15-gal. heating boiler. The valve *C* is left open to vent the air during the filling processes. After the pneumatic tank is filled, valves *A* and *C* are closed and *B* and *D* opened, air from the compressed-air system being admitted at *B*. By means of the valve *E* the operator regulates the flow of oil to suit the capacity of the filter.

MINE RESCUE WORK ON THE WESTERN WAR FRONT*

By Lieut. Col. D. DALE LOGAN, D. S. O., M. D., D. P. H.

I FIND that it is difficult to make people appreciate the very extensive scale on which mining operations were carried out on the Western Front. With the great increase in size of explosive charges used in craters and in camouflets, following upon the increased depth of mines, the more extensive mine systems, and the consequent increased personnel employed, the casualties from gas poisoning assumed serious proportions.

By far the greatest number of gas poisoning cases in mining were caused by carbon monoxide. As this gas is not naturally present in the soil, it could only result from the explosives used.

Gases from the detonation of a high explosive include carbon monoxide, hydrogen, and methane, all of which are combustible, and, when present in the proper proportion, explosive. Methane is never formed at the time of explosion, but results from the action of hydrogen on the oxides of carbon as the gas cools down, which it quickly does in the galleries. The greater the amount of hydrogen formed, the greater will be the proportion of methane.

When explosive gases are ignited, they do not explode at the point of ignition, but at a certain distance away. One grave danger from explosions of gas is the rapid flooding of the mine system by gas from the camouflet, owing to the combustion and explosion of the gas in the galleries causing a partial vacuum, so that the majority of the casualties from explosions of gas were due to carbon monoxide poisoning.

Attention was first directed to gas explosions by a serious one which occurred in January, 1916, when a tunnelling company suffered considerable casualties, the officer commanding, another officer, and 16 other ranks being killed.

MINE RESCUE APPARATUS

The Proto apparatus was the one chosen, as I considered it the simplest and most efficient rescue apparatus on the market. For scouting, and work which did not necessitate more than half an hour in the mine, the Salvus apparatus was used. In deciding on an oxygen resuscitating apparatus, it was necessary to remember the class of men who were to carry out first-aid; therefore it should be of the simplest type and foolproof. Automatic resuscitating apparatus, the best known of which is the Pulmotor, was rejected as being too heavy and complicated for use in the trenches, besides being dangerous even in the hands of medical men. The Novita apparatus was fixed upon, and modified to meet the conditions of military mining, being coupled up in a box ready for immediate use. The box and handles were arranged in such a way that it was easily carried down the shaft.

In the early days of mining, life-lines were used for hoisting men up the shaft. The difficulties and dangers of this method of bringing up an unconsciousness man, the constriction of the chest wall, and the serious effect this must have in certain cases, the danger of the rope slipping, and also the great exertion entailed in hauling a man along the galleries, showed the necessity of obtaining a stretcher which would be useful in the gallery and in bringing men to the surface. In a few weeks a mine stretcher, designed by Lieut. Penman, R. E., one of the officers in charge of mine rescue schools, was in use.

Mine rescue schools for the training of rescue men were started in each army. The officers in charge of these had skilled knowledge of rescue apparatus and rescue work in coal mines, and, in addition, they had the great advantage of having been previously engaged in actual mining in the trenches. From the beginning it was insisted that the training in wearing apparatus should be very searching in character, approximately as nearly as possible the work rescue men are called on to do in the trenches. The training in the schools included working at the face, either in clay or in chalk, driving and timbering galleries, recovery and disposal of the spoil, walking quickly, climbing vertical ladders, walking up inclines, and recovering a good solid substantial dummy from under *débris,* placing it on the mine stretcher, and bringing it to the surface. It was only by strenuous training that the men were given the necessary confidence in the apparatus, which is all-important in rescue work, and permitted them to face the most trying and difficult conditions. Not only must the men be accustomed to wear the apparatus, but they must have a thorough knowledge of every part of the apparatus and its uses.

In companies efficiency in rescue work was maintained by weekly practices. The only possible way of getting good results from first-aid in the trenches is to have a rigid line of treatment, and that all should have a thorough working knowledge of administration of oxygen, and how to perform artificial respiration. Schaefer's method was the one fixed upon as the simplest, and it was the only one taught.

Mine rescue stations, in which rescue apparatus and material were stored, were organized in dug outs in close proximity to all mines. When convenient, one station served a group of mines, but when possible they were never placed more than 250 yds. away from any mine shaft. In certain cases it was found necessary to keep apparatus ready for immediate use at the shaft head. When this was done, it was kept in the cupboards specially designed for the purpose. Two trained rescue men were in constant duty at these stations. These men had a thorough knowledge of the position of each mine served by their stations, and were familiar with the various workings.

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*Abstract of Paper before Institution of Mining Engineers.

RESCUE WORK IN THE TRENCHES

In rescue work in the trenches, the necessity of not wasting time in recovering the dead until all chance of saving others had gone was insisted on; also that the object of rescue work is not only to save life but to prevent further accidents; consequently obedience to standing orders must always be most carefully observed. The mine rescue men were frequently called upon to deal with fires in dug outs, and their work proved of the greatest value, saving a considerable numbers of lives and much valuable material.

In the rescue stations asbestos hoods and coverings for the Proto apparatus, so as to give protection against heat, were stored. Fires in mines were rarely encountered.

SAFETY RULES FOR OXY-ACETYLENE WELDING

The Western Pennsylvania Division of the National Safety Council has been making a study of both safe and unsafe practices in the care and operation of welding equipment now so widely employed. The following rules have been formulated for the guidance of those who use the oxy-acetylene torch, or who transport or care for the gas holders:

OXY-ACETYLENE EQUIPMENT

1. All pressure tanks should be fitted with safety relief devices, and tanks not so equipped should not be used.

2. The equipment should include a high-pressure gage to indicate the pressure on the tank, a reducing valve, and a low-pressure gage to indicate the pressure on the torch. These should be assembled as one unit and so arranged that they need not be separated when they are attached to, or detached from, the tank. The two gages should have different-sized openings; one should have a right-hand thread and the other a left-hand thread so that they cannot be interchanged. There should be one of these units for the oxygen tank and one for the acetylene tank.

3. All pressure regulators should be equipped with a safety relief valve which will relieve the pressure from the diaphragm and low-pressure gate in case the high pressure valve should develop a leak.

4. Wire-wrapped hose should not be used.

5. The oxygen and acetylene hose should be of different color or the couplings should be stamped for identification purposes, so as to avoid inter-changing the hose.

6. The torches should be of a type which will not backfire.

RULES FOR OPERATION

1. Under no condition should acetylene be used where the pressure is greater than fifteen pounds per square inch.

2. Special care should be given to the storage of oxygen and acetylene tanks. Acetylene is classed as an explosive, and only a limited number of containers should be stored in any one place. Oxygen tanks should be stored in a separate place from acetylene tanks.

3. Oxygen and acetylene tanks should not be allowed to remain near stoves, furnaces, steam heaters or other sources of heat, and should not be exposed unnecessarily to the direct rays of the sun, as an increase in the temperature of the gas will cause a corresponding increase in the pressure within the tank. Any excess of heat may also soften the fusible safety disk with which the tank is provided, causing it to blow out and permitting gas to escape.

4. Oxygen tanks should never be handled on the same platform with oil or grease which might find their way into the valves on the tanks.

5. Oxygen and acetylene tanks should never be dropped nor handled roughly and should never be stood on end unless fastened so as to prevent them from falling over.

6. Tanks should not be handled by crane, either magnetic or mechanical.

7. All empty tanks should be marked plainly with the word "empty" and returned promptly to the store room.

8. An open flame should never be used for the purpose of discovering leaks in acetylene tanks. Leaks can generally be detected by the odor of the acetylene gas, and their location can be determined by applying soapy water to the surface of the tank and watching for the soapy bubbles formed by the escaping gas.

REPAIRS TO EQUIPMENT

9. No repairs to oxygen or acetylene tanks or equipment should be made or attempted. All defects should be reported promptly to the foreman, and by him to the manufacturer.

10. Leaking acetylene tanks should not be used, but should be placed in the open air and all open lights kept away from them. All leaking acetylene tanks should be reported promptly to the foreman and immediately returned to the manufacturer.

11. All open flames should be kept away from

any place where there is any possibility of acetylene escaping.

12. Care should be taken to protect the discharge valves of tanks from being bumped, as a jar may damage the valve and cause it to leak.

13. Grease in contact with oxygen under pressure may cause spontaneous ignition. Great care should be taken not to handle threads or valves with oily hands or gloves, and gages should not be tested with oil or any other hazardous carbon. If a lubricant must be used, the purest glycerine is permissible.

14. Gages, apparatus, and torches requiring repairs should be sent to the manufacturer, and local repairs should not be attempted. Valve seats should never be replaced except by the manufacturer.

USE OF PRESSURE REGULATOR

15. The use and operation of the pressure regulator or reducing valve on oxygen or acetylene tanks should be as follows:

a. Open the discharge valve on the tank slightly for a moment and then close it. This is to blow out of the valve any dust or dirt that might otherwise enter the regulator.

b. By means of the stud or nut connection on the regulator, connect the regulator to the discharge opening of the tank.

c. Release the pressure adjusting screw of the regulator to its limit.

d. Open the needle valve slightly if there is one.

e. Open the discharge valve on the tank gradually to its full width.

f. Open the needle valve to its maximum, if there is one.

g. Adjust the pressure regulating screw until the desired pressure is shown on the low-pressure gage.

16. The discharge valves on the tanks should be opened slowly, and care should be taken to avoid straining or damaging them by the use of a hammer or the wrong kind of wrench. A special wrench should be made for use in opening these valves in case they stick.

17. When the operation of the cutting or welding torch is stopped for a short time, the needle valve on the regulator should be closed, or the pressure-adjusting screw should be released to keep the pressure off the hose. The torches should be opened momentarily to let the pressure out of the hose lines.

18. All tanks should be inspected at the close of the day's work.

19. Proper precautions should be taken to protect the hose from flying sparks.

HOSE AND JOINTS

20. All hose should be examined periodically at least once every week. This should be done by cutting the hose off at the end of the connection and examining it. In addition, after a few months' use, the hose should be cut off about two inches back of the connection and examined for defects. A defective hose should never be used.

21. Special care should be taken to avoid the interchange of oxygen and acetylene hose or piping, as this might result in a mixture of these gases that would be highly explosive. The practice of using right and left hand threads is recommended.

22. White lead, grease, or other similar substances should never be used for making tight joints. All joints and leaks in equipment should be made tight by soldering or brazing.

23. The oxygen and acetylene valves at the base of the torch should be tested daily for leaks.

24. Where hydrogen or other gas is used instead of acetylene, the same precautions should be observed as for acetylene.

25. A fire extinguisher should be carried as regular equipment to be used in case of fire.

26. Men using welding apparatus should wear suitable welding goggles for eye protection, having frames that are non-conductors of heat (not celluloid), side shields to protect against hot particles of metal, and lenses of proper color.

27. Operator's clothing should be fire proof.

28. If valves become frozen, they should be thawed by hot water, not by flame or hot metal rod.

THE LATEST OF THE GREAT AQUEDUCTS

When the size and resources of the city are considered, Winnipeg, Manitoba, may fairly boast of its recently completed aqueduct as a far greater financial and engineering achievement than the Catskill water system for the world's metropolis. Detailed particulars of the work we find in a recent issue of *Fire and Water Engineering,* and the account is well worth reading.

A concrete conduit, eight feet in diameter, ninety-six miles long, and costing more than $15,000,000 has just been completed and the water has been turned into the city mains. The aqueduct has been pronounced one of the world's major engineering feats. It is in its way a victory memorial. It was begun in 1914 and built in the four years of war. It is said that only four cities in the world have gone further for their water. The aqueduct brings 85,000,000 gallons every twenty-four hours from Shoal Lake, an arm of the Lake of the Woods, southeast of Winnipeg. Shoal Lake has an area of 107 square miles. The Lake of the Woods has an area of 1,500 square miles. The lakes are 300 feet above the level of the city and the flow of water is sustained by gravity.

The conduit tunnels under the Red River, Whitemouth River and several smaller streams. It passes twenty feet beneath the bed of Red River through solid limestone. The length of river siphons and pressure sections is seven miles. Winnipeg in its early history, obtained its water from Red River. Fifteen years ago after several typhoid epidemics, a system of artesian wells was established. But while excellent for drinking, the artesian water was so hard it ruined boilers, water tanks and city mains and had to be chemically softened for household purposes. The new supply of soft water will save the citizens annually $1,161,000 in chemical softening plants; $500,000 in scale and corrosion in pipes; $58,000 in cisterns and tanks; ; $41,000 in boilers; and $27,600 in hot water heaters, to say nothing of the reduction in the yearly bills for soaps and laundry work.

To build the aqueduct, the city constructed its own standard-gauge railway and a telegraph line. The road is 110 miles long and its locomotives and 115 cars are valued $1,439,522. Several thriving towns sprang up along the steel and farmers began to settle in the country which was before a wilderness. The road will not be maintained in regular operation. The city also operated its own gravel pits, rock quarries and cement plants.

MAN FOOD AND PLANT FOOD

A noted German scientist over twenty years ago was a prophet with a chemical bent of mind who figured out a great truth. He said that Europe would face a soil exhaustion unless it took steps to stop it, and Germany in particular. He pointed out that an enormous advantage would be gained by importing raw materials and food stuffs which are rich in plant food and by exporting finished products and manufactured articles, chemicals, toys and products of the soil which contain little or no plant food, a balance would be struck.

And then he made the startling announcement that sugar made from beets was the finest thing to export. The beets themselves required excellent soil, but the sugar, the refined product composed of oxygen, hydrogen and carbon, did not have any chemical value as plant food. When the pulp and the leaves were returned as manure the soil would never be depleted.

The theory advanced in the preceding paragraph was the thesis of a scientist at the University of Gottingen and the creed that he formulated was this: "In every million bushels of wheat we purchase from America there are 1,575,000 pounds of plant food, nitrogen, phosphoric acid, potash which is worth 25 per cent. of the price of the whole wheat. In 20,000,000 pounds of sugar that we sell to pay for this wheat, there is not one "pfennig" worth of plant food.

The government is, therefore, justified in paying a bounty on all sugar exported because in fostering and increasing the sugar industry more than one purpose is accomplished. Not only are the agricultural resources of Germany built up and the development of the beet sugar industry in the United States discouraged and prevented, but when the time comes when Germany will be compelled to produce her own breadstuffs our rich sugar-beet fields will be ready."

COMPRESSED AIR HELMETS

The following question and answer we find in *Fire and Water Engineering*. The answer seems to be practically indisputable:

To the Editor:

In spite of all the talk about army masks and self-contained breathing apparatus, is not the compressed air helmet the most common-sense and efficient one of all? Surely the helmet which furnishes air as it it to be found in nature is the most sensible. In your discussions why do you not say something about the compressed air helmet?

Respectfully yours,

G. M. S.

South Bend., Ind.

Answer: The less said about the compressed or liquid air helmet the better. Some attempts have indeed been made to utilize liquid air and compressed air in helmets. In ordinary breathing, however, a man inhales and expires anywhere from 6 to 7 liters of air per minute during rest, up to 60 or 70 during vigorous physical exertion. It appears utterly impossible, on account of the weight of the air and necessary containers, for a man to carry with him either in compressed or liquid form such a supply as will enable him to have entirely fresh air at each breath for any such length of time as breathing apparatus is worn in fire service. For service up to a maximum of 10 minutes a compressed air apparatus could probably be devised and might be serviceable, although it would probably be rather heavy and expensive.

LUBRICATING AMMONIA COMPRESSORS*

To perform its functions properly, a lubricating oil should have body sufficient to keep bearing surfaces apart; should reduce friction to a minimum; should remain fluid at the lowest temperatures to be met in service; should not decompose and form deposits that will gum up the machinery; should have no ingredients which can corrode or pit metal, and should have flash point high enough to insure against the presence of volatile constituents.

To avoid vaporizing too quickly under the high compression heat in an ammonia compressor cylinder, a lubricant must have a good flash, say, 325 deg. F., and as some oil in vapor form is likely to be carried into condenser pipes with the ammonia gas, the cold test should be low enough so that the lubricant will not solidify in the piping and coils —5 to 10 deg. F. If it is carried on through with the liquid ammonia, it can be taken out by an oil trap, placed ahead of the liquid receiver and at the lowest point in the expansion and condenser coils. Such a trap may be made of a piece of 4-in. piping, 2 ft. long, with a draw-off connection at the bottom.

If the lubricating oil gets into the condenser coils and stays there, it can be loosened by cutting off the water from one stand at a time, allowing the coil to became hot, so that the oil is thinned and will run off into the oil trap.

Oil carried over, and collecting in the condenser and expansion coils, is a source of lost capacity, and is frequently due to locating the oil separator too close to the compressor discharge, where the gasses are hot and the oil mostly in vapor form. Placing the separator near the condenser gives time for the gases to cool somewhat before reaching it, so that the oil is partly condensed and is more readily separated.

All oil used for the compressor cylinder should be measured and a record kept. Any unusual increase in the amount fed should lead to an immediate investigation to prevent filling of the system.

As hot ammonia gas has a bad effect on stuffing box packing, a liberal supply of oil should be applied to the piston rod in the stuffing box to reduce the chance for overheating.

Discoloration in the ice is not always due to oil. Two cases were mentioned in the discussion, one where firebrick was used to fill an open heater in which there were no flow pans, and the mineral matter from the brick carried over into the ice; the other where rust from a fore cooler caused the trouble, which was remedied by painting the inside of the fore cooler.

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*Paper and discussion, Nat. Ass'n. Prac. Refrig. Engrs.

SOME CONDENSED ADVICE ON COMPRESSOR LUBRICATION

Explosions in air compressors and receivers occur with sufficient frequency to demand careful attention. The majority of such explosions are undoubtedly due, either directly or indirectly, to the lubricating oil used in the air cylinders. Poor working conditions of the compressor, such as leaking valves, hot and dirty inlet air, insufficient cooling water, carbon deposit in cylinder or connections, and high speeds of poorly designed compressors, all assist in producing dangerously high temperatures of the compressed air. These high temperatures are sufficient to ignite the volatile constituents of the lubricating oil, and produce violent explosions.

The Massachusetts Boiler Board recommends the following rules:

(*a*) Keep the temperature of the compressed air, during compression, as low as possible.

(*b*) Keep the piston and valves tight, and in good working condition.

(*c*) Take the inlet air from as cool and clean location as practicable.

(*d*) Use plenty of cold water, from a source which is not liable to fail, and have it visible at discharge from cylinders or coolers,

(*e*) Do not use kerosene or other volatile substances in the cylinder, tanks or any connections.

(*f*) Use mechanical or sight feed oilers for the compressor cylinder.

(*g*) Use the least amount practicable of the best air cylinder oil. Air cylinders require much less oil than steam cylinders.

(*h*) Keep the cylinder, tanks and connections as free from carbon, accumulated oil and deposits as practicable.

(*i*) A good cylinder oil is one which lubricates well, leaves little or no deposit, is the least volatile at high temperatures, and has a high flash point.

MINE EXPLOSION SUGGESTIONS

It is likely when an explosion occurs in a mine that the cage, signaling devices, headframe tower, or derrick may have been wrecked or disabled, observes *Rescue and Recovery Operations in Mines.* Immediate preparations should be made to descend the shaft. To determine whether men are alive at the bottom, signals should be given by pounding on any pipes extending down shafts. Lack of response may be due to the pipes being broken. To make sure, get a ¼-in. rope, fasten to its end a lighted electric hand or flash lamp, a lighted safety lamp and a small cage containing a canary bird, and lower them to the bottom of each shaft. If men are alive at the bottom they may see the lights and give some signal or attach a message. The lower end of the rope should remain down five minutes, it should then be withdrawn, and the safety lamp and the canary examined. If the safety lamp is still lighted, and the canary alive or not disabled, men may safely descend the shaft, provided no change of ventilation in the meantime would cause the air in the shaft to change from still or intake to an upcase current. The return of the lighted safety lamp and the live canary will indicate that the oxygen content of the air is more than 17 per cent. (pure air contains about 21 per cent.) and that the carbon monoxide content, if any, is less than 0.20 per cent.

MINE-DUST SAMPLING

Tests are being conducted at the Pittsburgh station of the Bureau of Mines on the sugar-tube method of collecting dust samples from the air of metal mines, a modification of that used by Edwin Higgins in sampling dust in mines of the Joplin district. Preliminary experiments have shown that the old type of sugar tube had an extremely high resistance to breathing, amounting to from 15 to 20 in. at 16 liters per minute. This large resistance renders it impossible for a man to take a sample of appreciable size. As a result of experiments made with different dimensions of tubes, a size was found in which the resistance is reduced to only 3 in. of water at 32 liters per minute, and which is decidedly more efficient in removing fine dust.

On applying the standard tobacco-smoke test, it was found that the efficiency of the old type of sugar tubes was only 50 per cent. That of the new type will probably be about 90 per cent. Optical methods are used for determining the efficiency, and by such methods very fine particles can be distinguished—much finer than by any other method.

WESTINGHOUSE SCHOLARSHIPS

As a proper war memorial to the more than 8,000 employes of the Westinghouse Electric & Mfg. Co. who entered the service of the Government in the war, the company has decided to establish four technical scholarships each year under the following general conditions:

Candidates will be limited to sons of employes of the Westinghouse Electric & Mfg. Co. and its subsidiaries, who shall have been employes in good standing for a period of five years.

Two of such annual scholarships may be open to the younger employes of the company or its subsidiaries who have been in their service for a period of at least two years and who do not exceed the age of twenty-three.

The selection is to be determined by competitive examination to be conducted annually by the company's educational department, which will take into account not only the applicant's academic training and preparedness, but also personal qualifications, general character, and aptitude.

Scholarships will entitle the successful candidate to pursue a four year's course in any technical school or college that he may select with the approval of the committee. The scholar may pursue a course in any branch of engineering that he may select.

Scholarships will be granted for one year only, but will be continued for the full four years provided the scholar maintains the academic and other standards required by the college or institution in which he elects to pursue his course of study.

Each scholarship carries with it an annual payment of $500, to be made in two installments.

In a paper on "Powdered Fuel," read before the Sheffield Society of Engineers recently, Mr. J. S. Atkinson gave the following advantages for the system as regards control:—Positive control is obtainable as regards the amount of fuel burnt, the working temperature and the nature of the flame, oxidising, neutral or reducing. The control of the nature of the flame is very important in many cases, as, for example, in puddling; also, as it is possible to maintain a neutral or slightly reducing atmosphere in a furnace, scaling or slagging losses can be brought down to a minimum. Such savings in scaling often show more important total savings in the cost of production than even large economies in fuel.

In order that engineers and mechanics trained by the State shall, upon discharge from the Army, receive the positions for which they are fit, the University of California Alumni Association has established a Bureau of Occupations. The secretary is Homer Havermale, and his address is 201 California Hall, Berkeley.

In Ohio a new law forces gas companies and other public utilities to get permission of the State Utility Commission before discontinuing service. Now if a law were enacted that would force wells to yield ample quantities of gas, Ohio's fuel troubles would be less poignant.

Col. Douglas I. McKay has been elected president of the Pulverized Fuel Equipment Corporation, 30 Church street, New York, to succeed John E. Muhlfeld, who retires to return to consulting engineering practice.

MINING ACCIDENTS

The following is a brief abstract of an address by Albert H. Fay, U. S. Bureau of Mines, before the Mine Safety Conference at Duluth, June 20:

Mining is one of the extra-hazardous industries, employing more than 1,000,000 men in the United States of whom three or more out of every 1,000 men employed are killed each year by reason of some accident. While complete data relating to non-fatal injuries are not available, yet reports to the Bureau of Mines for all metal mines in the United States, show that at least 250 men per 1,000 per year are injured sufficiently to cause a loss of time. Approximately the same rate will apply to other branches of the mining industry.

In all industries there are a certain number of accidents that are inherent, for which it is impossible to place the blame on any one. These equal about 50% in the mining industry. The responsibility for the remainder may be placed about equally on the operator and the employee.

The campaign of education for employees in the various industries has also been extended to the mining industry to the extent that many of the larger operators are making special efforts to educate their workmen in various ways. So far as accidents are concerned probably the principal thing that can be done along educational lines is to see that the employees are thoroughly instructed in the English language, and as to the dangers which they encounter when they enter the mine, and to furnish them, through their superintendents and shift-bosses, instructions as to how to avoid accidents and to take care of themselves. Much of this educational work may be done through safety committees, consisting in part of members from the various occupations in and about the mines, giving the miner an opportunity to make suggestions that he considers will prevent accidents in his particular working place. Many of the companies have these committees actively at work, and they are meeting with gratifying results.

BEESWAX SAVES MINE PUMPS

The rapidly destructive corrosive effect of acid water in mines is frequently quite astonishing. Pumps have sometimes been rendered absolutely useless in two or three days. Harry Goodman tells in a recent issue of Coal Age how a simple, cheap and efficient method of protecting mine pumps from the corrosive action of some particularly bad mine water was recently tried out successfully at Herrin, Ill. After five pumps had been put on the scrap pile one after the other, Elmer Mayor, the top boss, conceived the idea of using beeswax on the parts of the pump exposed to the action of the water. Accordingly, he took apart a new pump, carefully wiped off all grease and dirt from the faces and even from the bolts that clamped the parts together. After carefully heating the clean surfaces he applied the melted beeswax to form an even, thin coating and bolted all the parts together with similarly treated bolts. The pump was then installed and has run without any further attention except the regular oiling. Before the beeswax was tried the pumps lasted from one to three days. The treated pump has been running for several months.

GUNPOWDER IN THE MACHINE SHOP

In the Delaware & Hudson R. R. shops, Watervliet, N. Y., according to *Du Pont News Service*, they are using ordinary black sporting powder for various operations such as: Blowing nuts and bolts and rivet heads, breaking up iron and steel to be scrapped, forcing a piston off when rusted fast, breaking metal that has become cold in a furnace.

The charge of powder is loaded in steel guns varying in size from end to end from 5 to 12 inches with other dimensions in proportion, and held by a steel plunger, which is forced out when the charge is set off. No wad is used. The plunger is milled to a size to fit the bore of the gun. Some of the gun-barrels are milled in the shape of an octagonal prism, instead of being cylindrical, the bore, of course, in all cases being round. The gun after having been loaded is jacked up with the mouth within about one inch of the object to be struck by the plunger and fired. An average of one ounce of powder is used for each nut or bolt (sizes in common use on locomotives) that is to be broken off or loosened. The load, of course, is varied with the work to be done. By the use of these guns, it is claimed much time and labor can be saved and that a quick blow can be directed at an object that is barely reachable otherwise.

A COMPRESSOR DETERMINED TO WORK

The following bona fide letter, reproduced practically verbatim, tells its own story with admirable completeness. It is addressed to the Ingersoll-Rand Company by the Oregonian Publishing Company, Portland, Oregon.

Some time in August, 1904, we ordered an air compressor from you through your then representative here. The machine, a Class E, 8 by 8 in., motor and chain driven, was installed in our plant in the early part of 1905.

This machine was put in on our air load, supposedly to run with an intermittent control—

which it did very nicely for about six months—when the service began to become a close succession of intermittent cycles just about continuous for twenty-four hours a day.

Last week, after about eleven years of windjamming, up to eighty pounds most of the time, our poor old Ingersoll began to show signs of wanting to drive the motor every time it stopped. It seemed to be developing an unusual amount of "pep" for an old sport—sort of coming back in its old age—did not want to stop when the motor did.

We decided that the old boy must be in distress in some way, so we took out the valves and found that they were actually worn out. So now we come to you for some new valves. Sorry we have to do this; and we are also afraid that the new valves, some way, will not be as good as the old ones, but we will have to take a chance.

We wore out the control furnished originally with the compressor; we have worn out several chain drives, and some armatures on the motor—but the old Ingersoll compressor has been our friend day and night—through thick and thin—and, gentlemen, we sure appreciate the service you have rendered us in slipping us this machine. If you ever have any skeptical prospects in this Northwest territory who seem to hesitate about buying your apparatus, just send them around and we will convince them.

Enclosed please find requisition covering order, which we trust you can ship in the near future, as we do not want that old sport to overdo, in trying to run that motor as a generator.

NEW AMERICAN EXPORT RECORDS

A remarkable increase in exports during June brought th total for the fiscal year 1919 to more than seven billion dollars, a new record, according to a statement issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. The June exports were $918,000,000, which exceeded the previous high record, established in April of this year, by more than $200,000,000. The exports for June of last year were valued at $484,000,000. Total exports for the fiscal year stand at $7,225,000,000; as compared with $5,920,000,000 for the fiscal year 1918. This is more than three times the exports for 1914, the last normal year.

Exports since the armistice was signed in November are estimated at about $5,000,000,000. The excess of exports over imports for the fiscal year 1919 was $4,129,000,000 against $3,000,000,000 the previous year and less than $500,000 in 1914.

The removal of wartime restrictions caused a decided increase in the exports of gold. from less than $2,000,000 each in April and May to $83,000,000 in June. Gold exports for the fiscal year amounted to $117,000,000, against $191,000,000 for 1918. Exports of silver fell off from $29,000,000 in May to $13,000,000 in June, but increased from $139,000,000 for the fiscal year 1918, to $301,000,000 for 1919.

DIESEL ENGINE AND SEMI-DIESEL ENGINE PRECISELY DEFINED

A Diesel engine is a prime mover actuated by the gases resulting from the combustion of a liquid or pulverized fuel injected in a fine state of sub-division into the engine cylinder at or about the conclusion of a compression stroke. The heat generated by the compression to a high temperature of air within the cylinder is the sole means of igniting the charge. The combustion of the charge proceeds at, or approximately at, constant pressure.

A semi-Diesel engine is a prime mover actuated by the gases resulting from the combustion of a hydro-carbon oil. A charge of oil is injected in the form of a spray into a combustion space open to the cylinder of the engine at or about the time of maximum compression in the cylinder. The heat derived from an uncooled portion of the combustion chamber, together with the heat generated by the compression of air to a moderate temperature, ignites the charge. The combustion of the charge takes place at, or approximately at, constant volume.

INFLAMMABILITY OF ALUMINUM DUST

As prepared, the aluminum dust of commerce is finely divided aluminum metal with a coating of oil, usually stearine or some similar material. This coating evidently serves to prevent oxidation in air and to protect the metal particles from the action of moisture, as it is stated that the product loses its lustre if no oil be added. Aluminum dust is so light that it is easily blown about a room, and as the workmen seldom take precautions to prevent this the workrooms are soon coated with the dust.

Evidently all apparatus should be inclosed to prevent loose powder from being blown into the air. Although experiments do not show the exact conditions under which an ignition of the aluminum dust is obtained they do show that it may ignite at temperatures even lower than those necessary for the ignition of 200-mesh standard Pittsburgh coal dust; also more heat is needed to ignite aluminum dust. The dust used in the tests was a commercial product labelled "aluminum bronze."—*Technical Paper 152, U. S. Bureau of Mines.*

THE SKY PATROL FOR FOREST FIRES

The government has converted part of the war-time air fleet into a national forest patrol, with dirigibles, scout planes, flame extinguishing bombs and sky-riding firemen to save the billions of feet of timber annually destroyed by forest fires. The experiment is being launched in the Cleveland and Angeles national reserves in California, the U. S. Forestry service and the army working together. Successful there, it will be extended to the other 145 reservations throughout the country as fast as districts can be organized.

Under this system, fire fighters will be rushed to incipient blazes it formerly took hours to reach. Bombing planes will smother small fires. Trained fire-fighters will be lowered by rope ladders from anchored dirigibles. And balloon sentries, in communication with forest posts by wireless, will hang over danger areas. The first of these sentries is on the job at Arcadia, Cal. Daily he soars to his 3,000-foot-high post. Then at ten each morning, two planes leave March Field, near Riverside, following routes from which the heavy forest can be scanned for over one hundred miles.

A second patrol covers the district in the afternoon. In these planes the observers carry maps on which the forest is ruled off in squares, keyed by plainly visible landmarks and villages. A discovered blaze is immediately marked in the corresponding square on the map. The machine pilot then swoops low over the nearest village, drops a parachute message asking the finder immediately to phone the information to the district supervisor, or goes back to report personally.

All residents have been informed about these messages and how to co-operate. Meantime, the dirigible at Arcadia remains aloft throughout the day, in wireless touch with ground stations where trucks suitable for hard mountain travel stand ready for instant use and a squad of ten enlisted men is prepared to rush into the forest with extinguishers, axes, picks, tanks of water and canteens.

A UNIQUE MINE RECORD

The deepest metal mine in the world, a gold mine, and one of great age as mines go, is the St. John Del Rey in the state of Minas Geraes, Brazil. *The Mining and Scientific Press,* San Francisco, brings together the following data from its latest, the 88th, annual report, the enterprise being British.

Last year the output of gold was worth £423,029, or about $2,000,000 in American money. Th average yield from 165,000 tons was $13.27. The profit was $590,244, which was $90,000 less than in 1917, the decrease being due chiefly to the adverse conditions created by the War. A dividend of 10% was paid for the year 1918. The workings have reached a vertical depth of 6326 feet. At the bottom the temperature is 116°F. when the ground is first penetrated, and even the mean temperature of the air underground during the summer is close to 100°, so that particular pains has to be taken to ventilate the mine with a view to rendering working conditions tolerable. The natural increase of temperature is one degree per 126 feet of descent.

A large Sirocco fan is used and it is proposed to supplement this with an air-cooling plant. The deeper portion of the mine, below 1,940 ft., has been opened up in a most unusual way, by means of a steplike system of winzes and levels, each winze being 1200 feet long and connected with four levels at intervals of 300 feet, so that, as a Cornishman would say, "the h'ore is pulled out by the 'air of the 'ead." The scheme of development depends upon the fact that the workings follow not the dip of the lode but the pitch of the orebody, which stands at an angle of 40°. It is pleasing to note that the size of the orebody and the quality of the ore have shown improvement on the lowest 'horizons,' as they are called, although the showing is not so good as it was in the younger days of the mine, the dimensions of the orebody at 5800 feet being about 15 feet by 1,000 feet, as against a width of 45 feet and a length of 600 feet in the upper workings. The reserve of ore amounts to 1,209,104 tons.

GEOLOGY AT A GLANCE

PROMOTERS and reporters play the very devil with geology, exclaims the *Mining and Scientific Press.* For instance, we read in one of our local papers that the president of a mining company at Tonopah "reports everything in tiptop condition." No wonder, for "at present they are in a formation of anthracite and pophyry, which is the true foundation to make ore in the Tonopah district." We hasten to the help of a bewildered reader by suggesting the substitution of 'andesite' for 'anthracite;' but even that will not suffice to make sense, because the andesite is a 'porphyry,' that is, an igneous rock in which some mineral is so prominent structurally as to give it a speckled appearnce. In this same Nevadan prospect we are told that "they will soon cross-cut on the 200 and then some real developments are bound to be found." This is an excellent example of journalese, using the abstract instead of the concrete; we hope they will find some real ore, that is, 'pay-ore,' instead of anything so indefinite as 'developments.' One can find them without incurring the cost of mining.

Recognition of Roosevelt for Building Panama Canal

By DANIEL SULLIVAN

WHEN GENERAL GOETHALS received the John Fritz medal last May for his work in building the Panama Canal, he made it plain, in accepting the "distinguished service medal" of the engineering societies, that the Canal would never have been possible but for the unfailing aid and coöperation of another. That other was, of course, Theodore Roosevelt, and General Goethals very fittingly took occasion at this opportunity to remind his audience of the courage and steadfastness and foresight which Roosevelt exhibited in bringing to fruition one of the greatest engineering feats of all time.

It needed courage to hew through the very determined opposition to action in starting the Canal work which Roosevelt found facing him in his own country more than it did to meet the obstacle of non-consent that was raised by the so-called government of the Republic of Colombia. Courage was indubitably Roosevelt's characteristic, but never perhaps was his faculty for decision more positively illustrated than in his course in connection with the starting of the Canal.

In fact this decisiveness in the manner of his determination of the kind of canal to be built and the best place to build it is in many respects more remarkable than the swiftness with which he took action in coping with international difficulties that, as he himself said, threatened to result in another half century of conversations without any actual work being done to dig the Canal.

If not the greatest of his achievements, the building of the Panama Canal was one of the most important of Roosevelt's during his tenure of the Presidency. And it was peculiarly his achievement. Without his active interest, his courage and his daring it is certainly open to question whether instead of a permanently useful link between the oceans there would be today on the Isthmus of Panama more than the unsanitary ditch of the unfortunate de Lesseps. But Roosevelt's part in deciding the route and type of the Canal to be built, his keenness and foresight in going against the opinion of the majority of the engineers may well have been lost sight of, so long has the Canal been an accepted fact and so long has this great waterway been carrying the commerce of the world.

That the Panama Canal as a lasting benefit to the whole world is distinctively the work of Theodore Roosevelt it is well to remember in connection with the campaign of the Roosevelt Memorial Association which will be held throughout the country during the week of October 20-27. In this achievement alone he was chiefly instrumental in providing for the world a permanent material benefit, whose value is beyond computing; and, if for no other reason, here is a tangible work which makes incumbent upon patriotism and gratitude the most widespread and generous response to the appeal for funds for a fitting memorial.

A NEW SERIES OF ARTICLES ON MIDWESTERN INDUSTRIES

IN THIS issue of Compressed Air Magazine begins the publication of a series of articles on various industries in which compressed air and pneumatic devices are largely employed. These articles are written by Francis Judson Tietsort, Managing Editor, who lately completed a trip through Middle Western and Northern States on behalf of this publication. He visited tire-making, automobile, chemical and steel plants. Mr. Tietsort also spent considerable time on the copper and iron ranges of the Lake Superior country, having some unusual and highly interesting experiences both underground and on the surface at the mines in the Northern Peninsula of Michigan and in Northern Minnesota. These articles, which are to be illustrated, are prepared in popular vein and will be as interesting to the layman as to the engineer and production manager.

According to an estimate published by the National City Bank, New York, the capital investment for each worker employed in American manufacturing industries increased from $2,117 in 1904 to $2,848 in 1914. An estimate for 1919, based on increased cost of production and price of product, would probably place the figures at $4,000 or more.

A Nebraska farmer reports that he turned the exhaust of his tractor into a corn crib and killed a bushel of rats.

Labor leaders are asking Congress to appropriate millions for an employment service, and yet declare that we are facing a shortage of labor.

Notes of Industry

Carter Glass, Secretary of the Treasury, announces that because of the great popularity and extensive sales of war savings and thrift stamps, the government will establish the savings plan on a permanent basis. The net cash receipts of the U. S. Treasury as a result of stamp sales up to June 30 of this year amounted approximately to $956,000,000. The Government is waging a campaign against dealers who buy in war savings stamps and Liberty bonds. It is also calling attention to smooth stock salesmen for dubious, if not fictitious issues, and requests that persons approached by them inquire whether these gentry will guarantee one's money back with interest on ten days' notice. Of course they will not. The Government then points out that it will do just that for its small investors.

In the course of a lecture at the Royal Institution, Professor Bragg said it was important that we should have some means of knowing when a submarine was within a mile of the "hunting" ship. The question of listening under water had been much studied during the war. "The perfect system," declared the lecturer, "is more than on its way. The Admiralty practically has it in hand. It will be a great day for all of us when we can say, not as members of the League of Nations, 'You shall not build submarines,' but as members of a nation which can declare: 'You can build as many submarines as you like. They have lost all their terror for us.' "

According to a summary made by the United States Fuel Administration, figures show that the saving in fuel consumption alone in 1918 due to the daylight saving was 1,250,000 tons. In one city the people saved $60,000 in gas and much more in electricity; the average sized city saved from $30,000 to $40,000 in lighting and fuel cost.

Tables recently published by the Forest Service of the Department of griculture show a lumber production in 1918 of 32,760,000,000 feet as against 36 billion feet for 1917. Decrease in lumber production has been most marked in Southern and Eastern states.

The sudden ending of war demands left the New York Air Brake Co., with its plant extended for war work and a civilian demand for air brakes far below its increased capacity for production. To take up the slack the company is turning to the manufacture of trucks and talks also of tractors.

Officials of the Bureau of Standards are now conducting experiments for the purpose of determining the value of different mixtures of concrete made with the Brown atomizer. This apparatus consists of a rotary mixer and a device for blowing the mixed concrete through the hose. The hose is directed by the operator to the form or walls where the concrete is to be placed. Results show that concrete blown with hot air is superior to others, and the experiments will be continued during the coming months.

The coal producers are warning the public to buy coal supplies at once and prevent a coal famine next winter. "To be coal warned is to be coal warmed."

Fifty miles in 26 minutes, 23.2 seconds is the latest speed record reported in an automobile race. This record was made at Sheepshead Bay, New York City by Ralph De Palma. It is equal to 113.7 miles an hour.

According to the reports of French engineers who have investigated the mines flooded by the invading Huns, 30,000 hp. of pumping equipment will be required for two years to free the mines of water.

The manufacture of nitrates by the fixation of atmospheric nitrogen is rapidly becoming a world industry. In this the Japanese are keeping in line with American and European enterprise. D. Takamine has, it is said, purchased, on behalf of Japan, the American modification of the Haber process. It is intended to instal a plant to use this process for the production of synthetic ammonia. The Japanese Government has provided means for the building and maintenance, in a suburb of Tokio, of an experimental laboratory for research concerning the conditions of the fixation of nitrogen.

Acetic acid is being manufactured from cocoanut shells in Ceylon.

John Canton, a riveter at the Morse Dry Dock, South Brooklyn, together with his two helpers, has established a small crew record of 9,153 rivets in eight days, or an average of 1,144 rivets every eight hours. Victor Sobatino and his two helpers of the same plant, drove 5,760 rivets in six days, or an average of 960 for each eight hours. These are the kind of riveting records that count, as they are not spurts on a given day for which the stage is set, using six or eight men, but constitute continuous performance under normal conditions.

Personal Intelligence

The Submarine Boat Corporation doffs its hat to Mr. O. Briggs, of Newark, N. J., a joiner foreman on the company's Wet Dock, who has been employed eighteen months. Mr. Briggs is not only a hustler on the job, but has never lost a day, an hour, or a minute, has never clocked in late, nor clocked out ahead of time. His batting average of 1.000 is worthy of note in many other industrial plants.

* * * *

Maj. Charles B. Going was discharged on his return from France after eighteen months service. During his entire service he had done editorial work on the Ordnance Encyclopedia and on various histories of the Ordnance Department in the A. E. F. He is a graduate of Columbia University and before entering the service edited and managed the magazine and book publications of the Engineering Magazine Co. His permanent address is Salamagundi Club, New York City.

* * * *

The American Institute of Electrical Engineers elected Calvert Townley president at the recent annual business meeting held in New York City. Mr. Townley is assistant to the president of the Westinghouse Electric and Manufacturing Co. He was born Oct. 18, 1864, in Cincinnati, Ohio, and was graduated from the Sheffield Scientific School in 1886, afterward taking a mechanical engineer's degree in 1888. He has been connected with the New York, New Haven & Hartford R. R. as vice-president in charge of electrification out of New York, subsequently becoming first vice-president of the Consolidated Railway Co. (afterward the Connecticut Co.), president of the Lackawanna & Wyoming Valley R. R. Co., and vice-president of the Niagara, Lockport & Ontario Power Co.

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Lewis A. Belding, who for the last two years has been assistant professor of mechanical engineering at Stevens Institute of Technology, Hoboken, N. J., has become associated with the Thomas A. Edison interests at Orange, in the power service division, as service engineer.

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Homer L. Ferguson, president of the Newport News Shipbuilding and Drydock Company, is the new president of the Chamber of Commerce of the United States. He succeeds Harry A. Wheeler, who after serving as president of the Chamber during the first two years of its existence and again last year during the war emergency, declined re-election. Mr. Ferguson was elected by the board of directors of the Chamber on a vote taken by mail. His was the only name placed in nomination by a nominating committee which met immediately after the conclusion of the seventh annual meeting of the Chamber of St. Louis.

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Henry M. Robinson, Pasadena, Cal., has been appointed a member of the Shipping Board to replace Charles R. Page, of San Francisco. Walter S. Reed, treasurer, will succeed George T. Smith; P. J. McAuliffe will succeed Daniel Cox, head of ship construction division; R. E. Talbert will succeed M. D. Ferris, head of contract division; Capt. R. E. Bakenhus, United States Navy, will succeed Admiral H. H. Rousseau, head of the shipyard plants division; M. H. S. Rollason will succeed A. E. Pfeiffer, head of the material supplies department. No reports have been received as to the successors of Gordon Wilson, general auditor, and R. W. Leatherbee, head of the industrial relations division. S. M. Evans, Orange, N. J., will succeed Howard Coonley.

* * * *

Thomas W. Pangborn, president and treasurer of the Pangborn Corporation, Hagerstown, Md., has been appointed a member of the Maryland Readjustment Committee which will give aid and counsel in matters applying to manufacturing, finance and transportation. Mr. Pangborn will represent the western part of the State, serving with the following: Governor Emerson C. Harrington; William Ingle, president, Baltimore Dry Dock & Shipbuilding Co.; A. W. Thompson, vice-president, Baltimore & Ohio Railroad; A. C. Bruce, president, Bartlett-Hayward Company, and others, totaling fifteen.

* * * *

A. F. Hartigan, of Chicago, in laying a standard gage track to the site of a large industrial plant which was practically under water, built the track in sections, using cedar ties, and floated the track to place. The track was anchored to preserve the alignment. Cars loaded with sand were run out and the material dumped in ridges on which the workmen stood in working the filling material under the ties.

Something for nothing is pretty nearly realized by the different states which are to receive from the war department, free of charge, except for transportation, 20,000 surplus motor trucks of 2 to 5-ton capacity that cost more than $45,000,000 and are to be distributed by the war department for use in the construction of Federal Aid highways.

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W. L. SAUNDERS, *Editor*
FRANK RICHARDS, *Technical Editor* FRANCIS JUDSON TIETSORT, *Managing Editor.*
CHARLES A. HIRSCHBERG, *Business Manager.*

Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

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BRINGING MISS COLUMBIA BACK TO HER SOBER SENSES

WHEN MR. GEORGE HORACE LORIMER, editor of the *Saturday Evening Post*, wants his two million or more subscribers to absorb a certain salutary and wholesome idea, one like the following, for instance, he calls in an able writer who has a reputation for his work in fiction and explains about as follows:

"MR. BLYTHE, (or MR. GRAEVE, or MR. COBB, or MR. TURNER) there is getting to be too much frivolity, too much wasting of time and money, too much of a disposition to get much for little in this country. There is a tendency to regard idleness and unearned luxury as the great *desiderata* of life and we have got to do our share in stopping it. It is a dangerous, if not a fatal trend for any country. You will remember what happened to Rome. Study this situation and weave your findings into a novel which I wish you would do for me for publication in about six instalments."

The writer absorbs the idea, goes forth and gathers his materials and schemes out a narrative plot or structure, carrying out instructions much as a newspaper reporter would cover an important assignment for his city editor. The story is next written and illustrated and the editor's message is conveyed in the form of a candy-coated pill to millions of folk. The lesson or moral of the message are there in story guise.

* * * *

The foregoing may be considered as only an interesting incident of a campaign by editors, writers and government officials, by clergymen, educators, orators, and by thoughtful industrial production managers and other men of business in this country to bring the average citizen of the United States back to his senses. We have been getting up in the air and we must get our feet back on solid ground again. Incidentally we may well wish that there were more editors of the clear sanity of MR. LORIMER, who feeling their responsibility, would remonstrate and warn against a pernicious and all too prevalent state of mind that seems to have fallen upon us as a reaction from the days of wartime anxiety and sacrifice.

The country is undergoing an orgie of extravagance. At prevailing high prices we are not even buying sane, sensible things of perminent usefulness, which would be justified if we might get our money's worth. Money that ought to go into new homes is being spent for the costliest automobiles, bringing from $10,000 to $15,000 apiece. The jewelers report they cannot get enough of the costliest jewels to supply the demand. Women load themselves down with a queen's ransom in gems to outdo some other equally unwise woman. The example set causes folk of the middle class in worldly circumstances to become infected with the fever, and in turn those working for a weekly wage are seized with vaunting desires and dissatisfaction and demand high wages and short hours. Every boost in wages and every increase in the cost of materials is taken out of the ultimate consumer and the vicious circle continues on an upward spiral.

The old, and fallacious, excuse for buying something because it is cheap, assuredly has disappeared; nothing, or at least exceedingly little, that is desirable, is so cheap as to be a bargain these days. Yet people buy expensive luxuries without even inquiring the price. This presents a sore temptation to the retailer and it results in a condition that a degree of what we resignedly call the high cost of living is really the cost of high living. The office or shop girl wears silk stockings and dresses much as a lady of fashion, if not with the same richness of materials.

We saw a girl running a lathe in a machine shop recently, dressed in overalls, but she wore silk stockings and patent leather pumps.

A young Englishman, in New York for a few days on his first visit, en route for Brazil on business, was asked by us the usual question respecting how New York impressed him.

"It is a really wonderful and interesting place," he rejoined. "I am astonished by all I see, I admit. Everybody here seems so wealthy. And your women, including your typists and 'clarks'—my word—they are positively *duchesses*."

* * * *

We sought to hire a colored maid. She asked for $3.50 a day, one day and a half "off" per week, and positively declined to do any real work.

There is unquestionably a serious trend in America that must be faced and kept within bounds. On the industrial side workmen are showing in some lines a tendency to skimp in their work, and production lags. There is a cry for shorter hours.

Now seven of the usual eight hours claimed by business is in all conscience an average light day's work. If production falls off, prices go up naturally, and production takes time. The argument is that shorter hours make for increased efficiency, but this has not been proved. If working men and women were all working at good speed or giving a fairly honest output for eight or ten hours a day, there might be ground for considering a six-hour day at commensurate pay, but what employer is prepared to say he could view the prospect with equanimity? Very few, we believe.

Work is the thing that keeps one young; it keeps one from becoming *blasé*. The reverse of a degree of honest, wholesome, creative employment, is idleness, with a resultant struggle to find pleasure. Amusement and relaxation find a legitimate place in the life of every well-balanced man or woman, but when pleasure is pursued to excess, for its own sake, it invariably results in satiety. When the saturation point of satiety is reached the tendency of the individual then is to follow the abnormal for the sake of new "sensations." The result is crime and disease. The fibre of the will, the instinct for the best in life, is lost to that individual.

Why does the successful man keep on working after he has accumulated more than he can spend on the needs of himself and family? One often hears this question, and the exclamation follows, "If I had as much money as Mr. Gotrocks I'd quit and spend the rest of my life having a good time."

The answer to the question is simple. The very qualities that made the active Mr. Gotrocks successful prohibit an idleness that would be repulsive to him. He has been able to buy enough and see enough of the pleasurable things of this world to know that if he gave up working and abandoned himself to pleasures that he would quickly become sated and die of *ennui*. We know a man in his thirties who has a fortune of $30,000,000. He has practically always had it, but he is one of the busiest men in lower Broadway as head of three or four large corporations. He takes an almost childish delight in his recreations when he has a chance to take them. If he were to quit and liquidate his business enterprises he would throw 15,000 persons out of employment. As a producer he is making the world a better place in which to live, making others happy, or giving them a chance for happiness, through his industry, which enables them also to work and thrive.

* * * *

The best minds in both governmental and business circles are focussed on these problems, but each individual must consider them for himself and act as his conscience bids. We must stop cheating each other and cheating ourselves, for they are equivalents. No loyal, thinking American wants to see this mighty, well-loved land enervated. America must cling to her old wholesome ideas of industry. Her young sons who so lately have fought nobly overseas, and who have now returned, must come down out of the clouds. Her workmen must see that their interests and those of their employers are identical.

Let us dream of better things, by all means, but dream of honest achievements, for, as MARIE L. EGLINTON wrote:

Each dream that fires a mortal brain
  Some day can be made true:
Whatever man can faintly hope
  That can he strongly do.

Once, terrified, he scanned the skies,
  And feared each stone, each tree;
But something in him watched and strove,
  And led his spirit free.

Propitiate, but not with gifts,
  The Powers of heaven and earth:
They and their friendly use are yours
  By right of soul, of birth.

Dream, then, nor fear to dream too fair.
  (Each seed is made to swell.)
If hand and brain are linked by faith,
  God's realm is yours as well!

Dr. L. LEVINE recently quoted A. R. MARSH in an article in *The New York World* as saying that lowered factory and farm production constituted an important cause of high prices and that the crux of the problem was *the attitude of mind of working people which had resulted in a reduction of production.* Mr. MARSH had noted that in the cotton industry a large laboring force supplied with more machinery was producing less goods in 1919 than it had in 1916.

President WILSON in a late public statement declared:

"Only by keeping the cost of production on its present level, by increasing production and by rigid economy and saving on the part of the people can we hope for large decreases in the burdensome cost of living which now weights us down."

* * * *

In a recent article, STEPHEN LEACOCK, professor of political economy at McGill University, Montreal, declared to *New York Times* readers:

> The laborer will not work because the pay is too low and the hours are too long. The producer cannot employ him because the wage is too high and the hours are too short. If the wage is paid, and the short hours are granted, then the price of the thing made, so it seems, rises higher still. Even the high wages will not buy it. The process apparently moves in a circle with no cessation to it.
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> * * * The public mind is confused. * * * To some minds the demand for law and order overwhelms all other thoughts. To others the fierce desire for social justice obliterates all fear of a general catastrophe. The "State," as we know it, threatens to dissolve into the labor unions, conventions, boards of conciliation and conferences. Society, shaken to its base, hurls itself into the industrial suicide of the general strike, refusing to feed itself, denying its own wants.
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> * * * Never, then, was there a moment in which there was greater need for sane and serious thought. It is necessary to consider from the ground up the social organization in which we live and the means whereby it may be altered and expanded to meet the needs of the time to come. We must do this or perish. If we do not mend the machine, there are forces moving in the world that will break it.

Mr. LEACOCK comes to the conclusion, looking at it from the upper strata of life, that is, those who are in a degree comfortably situated, that the safety of the future lies in a progressive movement of social control, alleviating at least the misery it cannot obliterate, and based upon the broad general principle of equality of opportunity and a fair start. The chief immediate opportunities for social betterment, as this writer views them, lie in the attempt to give every human being in childhood adequate food, clothing, education, and opportunity.

The conviction is forced home on every hand that America must first look to its own welfare and make itself a leaven of sanity in a foreign world much worse off than are we.

* * * *

But let us think clearly. High prices, luxuries, leisure and fancied injustice, are only a part of our domestic troubles. We must realize that in large degree the social unrest even in our own country, is due to foreign agitators who are poisoning the minds of our workmen; making them forget our free institutions; making them forget what the Grand Republic has accomplished since George Washington and his fellow statesmen welded the original colonies into what has become the world's mightiest nation. The Rev. Dr. Newell Dwight Hillis, in an article in the September *McClure's,* which every level-headed American should read to absorb its every syllable, for it is one of the best expositions on the subject that has yet appeared in print, gives the answer to his question, "What is the Matter with the United States?"

Dr. Hillis gives ample reasons why every workingman should be a red-blooded American, why he should squelch the sophistry of the imported agitator who has not absorbed or understood America, who knows little or nothing of the physical facts about it, who assumes that conditions here are the same as they were back home in Europe. For a fancied self-advantage, every workingman or woman, before turning his weapons against the institutions of this republic, this eminent Brooklyn thinker shows us, and before choosing between Lincoln and Lenine, should consider that this republic is the only country in the world that offers a man a reasonable chance of doubling his wage, and later of quadrupling his earnings.

We are in the world's best zone for producing foods, as half of the good agricultural land of the globe lies between Alaska and Cape Horn, and we are so situated that there is promise that our 110,000,000 people of today will, within the lifetime of children now living, become 400,000,000, and the present 250 billions of property of this country become a thousand billions. All civilization, its laws, liberty, art, science and invention, are rooted in farming land, and of the five continents ours alone enjoys ideal conditions for food production.

Another reason why our people should hesitate before deserting Americanism and accepting Bolshevism is that the average annual income of our working people is four times the annual income of the other peoples of the world. The population of the world, we are reminded, is sixteen hundred millions, and its total income in 1918 was two hundred billions of dollars, of which the people of the United States received fifty billions. While we are one-sixteenth of the world's population, we receive one-quarter of its total income. Today it pays to be a citizen of the United States, pays richly, in terms of wage and income alone. To reprint what recently appeared in these columns, although we are only six per cent. of the world's population, yet we produce:

75% of the world's supply of corn;
60% of the world's supply of cotton;
25% of the world's supply of wheat;
66% of the world's supply of oil;
60% of the world's supply of aluminum;
50% of the world's supply of zinc;
40% of the world's supply of lead;
60% of the world's supply of copper;
40% of the world's supply of silver;
52% of the world's supply of coal;
40% of the world's supply of iron and steel;
20% of the world's supply of gold;
85% of the world's supply of automobiles.

Before the war, Dr. Hillis recalls, we owed the countries of Europe five billion dollars. We have paid the debt and foreign governments now owe us thirteen billions, while our gold reserves are the largest in the world. The political, financial and moral leadership of the United States of America are suggested by the simple fact that today twenty-five nations have given up autocracy or limited monarchy and become self-governing republics.

* * * *

While the wages of our working people have risen, the interest returns of the capitalists have fallen steadily. The time was when the rich were growing richer and the poor were getting poorer, but that day has passed from our country. In 1870 the interest rate in the west was 12%. Today it is 5%, even lower than the interst rates in rich New York. In a generation the interest rates have been halved. Meantime wages have mounted and everything tends to the diffusion of the good things of life for the average family.

Every human being in America has sixty slaves working for him in that our machinery equipment gives each person the results of sixty man-power, while the average person in the rest of the world has only ten man-power. Edison thinks that soon every American will represent one hundred man-power.

The "trouble" with us, Dr. Hillis finds, is not with our land, our resources, our government, or with a lack of opportunity. *The fault lies with our people.* The time has come when those revolutionists who hate our flag and wish to overthrow our institutions, must peel from themselves, or have peeled from them by others, the untruths and hypocrisies in which they are swathed. Blaming institutions and other people does not get the individual anywhere. The path to success lies in industry, self-reliance and obedience to the law.

Obedience to law! We may well think that over, while representatives of the stupid red-handed of Russia and their silly dupes shout:

"Down with the Government."

"Our people live in slavery!"

"Not Lincoln but Lenine."

"Look at those stores. Smash in the doors and take what is your own."

"Buy a gun. Buy a gun."

Such exclamations have been mouthed in our large American cities. This is rot, a disease germ, and it must be killed before it becomes epidemic, else eventually there will be an industrial and social cataclysm in even our richly favored land.

We must get back to our sober senses, to plain living, plain thinking, and away from ostentation and those weakening influences that dehabilitate and destroy.

The evidence is plain.

EXPERIMENTS WITH EXTREMELY HIGH PRESSURES

IN A RECENT bulletin of the West Virginia University Agricultural Experiment Station, Prof. B. H. Hite and associates present the results of work on "The Effect of Pressure on Microorganisms."

No living thing was found that could not be destroyed by pressure. Most bacteria, including those responsible for typhoid, tuberculosis and diptheria, are killed in three minutes by a pressure of 75,000 pounds per square inch. With higher pressures they can be killed more quickly, and vice versa.

Spores require much more severe conditions—higher pressures or much longer time. Spore forming organisms in the vegetation stage are easily killed, and sterilization may be accomplished by repeated brief applications of 75,000 pounds per square inch.

The above applies to room temperatures. Working at somewhat higher temperatures it would be expected that lower pressures would be effective, and this is true, but the explanation may not be as simple as it might at first appear to be, since the same is true of somewhat lower temperatures, the time-pressure death-point curves for 5 degrees C. and 40 degrees C. being practically the same. In sterilizing culture media, etc., it has been customary to work at 40-45 degrees C., to apply a pressure of about 100,000 pounds at the close of the day's work and to find everything sterile and ready for work the next morning.

Working at 4-6 degrees C., a pressure of 75,000 to 100,000 pounds per square inch must be released or any water in the compressed material will be converted into a mass of soft ice. On releasing a pressure of 200,000 pounds at room temperature water is frozen hard. Most other liquids contract on freezing, so freeze at higher temperatures when pressure is applied. Comparatively low pressures were found to be sufficient to freeze many liquids and the use of high pressure in obtaining low temperatures is suggested. Solid chloroform melting at 70 degrees C. was easily prepared.

The high pressure equipment used by Professor Hite and his associates is very simple and easy to construct. A high pressure cylinder may consist of a block of steel with a hole through it, the hole being closed at either end by steel plugs one of which is long enough to serve as a piston. The liquid to be compressed is completely encased in a lead (or other soft metal) packing which consists of a piece of lead tubing both ends of which are closed with lead lids. The pressure is applied to the packing and its contents. There are no leaks. The pressures obtainable are limited only by the strength of the cylinder and piston. Cylinders intended for very high pressures were built up of several concentric cylinders shrunk together and thoroughly stretched by applying higher pressures than were to be regularly used.

FANCIES THAT ARE SNATCHED FROM THE UPPER AIRS

ON A VERY warm day, ROLAND ROHLFS, aviator, flew six miles from Roosevelt Field, Mineola, Long Island, N. Y., into a temperature of twenty-five degrees below zero. He expected this kind of weather, for he wore several pairs of mittens and gloves and a heavy fur overcoat, and his head was completely encased in a fur and leather hood, out of which he peered through inset goggles. It was so cold six miles from New York on this tropical day that the airplane engine was chilled and refused to work.

Sounds like a fairy tale? Not at all, for the explanation of this phenomenon is, of course, that Mr. ROHLFS flew vertically instead of horizontally. From 2.33 p. m. to 5.28 p. m. he flew to a height of 30,700 feet, a height considerably greater than the summit of mighty Mt. Everest, and returned to his starting point. The world's record for altitude is claimed in behalf of Adjutant CASALE, a Frenchman, who was reported in June of this year to have reached a height of 33,136 feet. Mr. ROHLFS thought he could have beaten the CASALE record had he been able to keep his engine warm. One will concede this to have been difficult when sweeping through aerial space at the rate of 100 miles an hour in a temperature of twenty-five degrees minus.

The ROHLFS exploit set one ingenious editorial writer of the New York *Evening Mail* pleasantly speculating on a drowsy drone of a day in City Hall Place. As he put it, most of us do not care for a temperature of twenty-five degrees below zero even in midsummer. But then that temperature was reached six miles in the air above New York. Three miles or even two miles above the softening asphalt and radiating bricks and steel, the temperature is probably no higher than sixty degrees above zero on the hottest day.

Would not a change from ninety, say, to sixty degrees, be sufficient to restore the joy of life to the jaded and overheated city dweller? Why can't we invent gardens hanging between earth and sky, captive balloons with pretty gardens on platforms, with some sort of elevators up and down, and make our weather what we want it? The *Mail* man says the possibilities of finding a place on which to hang such a garden is plainly suggested by the existence and the achievements of the dirigible. Shall we laugh at the thought of a sufferer from hay fever going aloft to freeze the disorder out of his system instead of shutting himself up in a marketman's refrigerator? How many devices and inventions have been considered "impossible" before their actual accomplishment? In any event these were agreeable hot-weather thoughts for which the metropolis owed thanks to Mr. ROHLFS.

While the air experts were examining and checking up the ROHLFS barograph, a farmer out near Kansas City was raising ructions over his property rights to all the air above his farm, which he asserted was his private property and off and away from which he warned all aviator interlopers. He wanted no birdmen swooping down through his private air on to his farm, a'cutting up the wheat and potatoes and melon vines with the landing carriage of such a newfangled contraption. And he stuck a sign on the rail fence warning aviators away!

Now this Kansan declares unequivocally that he owns outright and in fee simple all the land just below his farm right down to the center of the earth and on the other hand that he owns right on up through the air to the top of space —and that no man has a right to fly through his air without his consent. He is going further than merely asserting—he is starting a lawsuit to prevent such use of "his" air.

A Washington writer finds this refreshing, especially to single taxers, for a nice legal point will arise. The earth is moving always one thousand miles an hour; turning around on its axis, it travels more than a billion miles a year in its whirling journey around the sun—and the sun, dragging the earth with it, is furiously rushing through space, heaven knows where, just now toward the blue star Vega.

Consequently the space above that farmer's land is not the same space now that it was a second ago. It is the same earth, under his acres, but not the same space above them. Does he get the title to all that new space as his farm whirls through infinity?

But let us by all means have these things settled. First thing we know owners of air compressors will be sued for sucking in and bottling up other folks' air without permission!

THE LINE BETWEEN BAROMETER AND TROUT IN POINT

THE BAROMETER is an instrument that is too little known to the layman. Navigators and dealers in weather predictions are familiar with it and use it, as do wholesale commercial fishermen. The modern, progressive surgeon is beginning to heed the barometer and hesitates to perform a capital operation unless he is favored by bright, clear, dry, "high pressure" weather, which increases the chances of his patient for recovery.

The vagaries of atmospheric conditions have a considerable effect upon the human system and effect one's spirits and energy unless he be gifted with an exceptional constitution and exceptional ebulliency of animal spirits and great energy. These conditions are likely to have an effect on fish and fishing, as we shall see.

The barometer, which is properly defined as an instrument for determining the weight or pressure of the atmosphere, and hence for judging the probable changes of weather, and for ascertaining the height of an ascent in an airplane or a balloon, was invented about 1643 by TORRICELLI at Florence. The cup or cistern barometer is made in its simplest form by filling a graduated glass tube about thirty-four inches long with mercury and inverting it in a cup containing mercury. The column of mercury in the tube descends until balanced by the weight of the atmosphere, and its rise and fall under varying conditions is a measure of the change in the atmospheric pressure. At the sea level its ordinary height is about thirty inches, or 760 millimeters.

No self-respecting sea novel of the old-time type, in depicting the peril of the queen's cruiser or the rover, or the gallant square-rigged trader, from impending tempest, failed to preface the Old Man's order to haul in the t'gallants and generally shorten sail, with a reference to an inspection of the falling "glass."

FORTIN's barometer, used for scientific purposes, is a form of cup barometer having an adjustable cistern. The marine barometer, the mountain barometer, the syphon barometer and wheel barometers, are also mercurial, but the aneroid barometer is based on a different principle. The barometer gauge is a form of manometer especially for measuring low pressures. The marine barometer, it may be noted, for use on shipboard, has its tube contracted at one part to a capillary to prevent rapid oscillations of the mercury, and is suspended in gimbals from an arm or support.

In horology a barometric error is a very small error in the time of a clock caused by changes in the density of the atmosphere. In meterology a barometrical gradient is the rate of fall in atmospheric pressure between two stations; or it indicates the slope of an isobaric surface. In England and America it is usually expressed in hundredths of an inch of mercury for one degree (sometimes one-quarter of a degree) of sixty nautical miles. Thus, a barometric gradient of ten indicates a difference of reading of one-tenth of an inch on the barometer for two places one degree, or one-quarter degree, apart. On the Continent the millimeter is used instead of the hundredth of an inch. Increasing steepness of gradient is accompanied by increasing force of wind; a gradient of six represents a strong breeze; of ten, a stiff gale.

It is furthest from our thoughts to make these definitive observations a treatise on barometrography. Were one not a disciple of the gentle fisherman-philosopher, ISAAK WALTON, the many centuried anniversary of whose birth was celebrated in song and editorial this passing summer, reflections from the barometric glass would possibly not be thus in evidence. But an apparently scientific fisherman, of studious habits and a happy faculty for expression, MR. JAMES V. INGHAM, has a sporting theory that the trout angler's success is indicated by the barometer, and that this goodly instrument to record air pressure in time may become a necessary part of every fisherman's outfit. Who are commentators on the business and industrial aspects of air that they could even be tempted to overlook so absorbing a thesis?

Mr. Ingham offers us in an article in *The New York Sun* a possible if not a plausible solution of a problem which up to the present time remains a *questio vexata* to all trout fishermen. In so doing he gives one a grateful hour of detachment from the chatter of the club car of the Congressional Limited on the cost of high living, what the Brotherhoods will do next and whether the ratification cat will jump to the side of the Versailles pact. We forget the foreign demand for air compressors to bottle up superfluous Boshevik sputterings that clutter the Continental atmosphere, and stop speculating on the size of the air hoist that will be required to lift our personal gold reserve into the Sub-Treasury when we get our clutches on Aladdin's lamp.

Pause is given quite naturally to other daytime fancies when one sees in cold print Mr. Ingham's reference to the well known but highly unpopular idiosyncrasy of the varieties of salmonidæ which manifests itself at various times by their obstinate and persistent refusal to take the slightest notice of the most attractive flies, no matter how lightly dropped by the expert caster, though the conditions of weather and water are apparently just the same as those of the day before, when the sport was good. One is maddened to see the beautiful fish at the bottom of the pool, apparently indifferent either to subjective or objective impressions, tempted neither by curiosity, nor influenced by hunger to essay the capture of the strange insects fluttering on the surface of the water above.

Our theorist had bad luck one day. Then he chanced to remember that his aneroid barometer —he seems to belong to the delightful school of one's grandfather who puttered around with thermometers and barometers and weather vanes and sun dials and such—had fallen half an inch on the morning of his arrival at the stream. This brought on an attack of careful consideration of the effects of a diminished air pressure upon the surface of the water. The possible solution of the problem of the coyness of the trout became at once apparent.

One of greater temerity than one who both writes and fishes, and who philosophizes as well, must undertake to spoof the theory of the conclusions reached. It is taken as a fact that all fluids absorb gases under pressure, and just as readily part with them when the pressure is removed, so it must follow that with a diminished air pressure upon the surface of the water that some of the air which the water has absorbed while under a greater pressure or while passing through the rapids of a stream, must leave it.

Now—as the fall of half an inch of the barometer indicates a loss of one-fourth of a pound of pressure on each square inch of surface, some of the air contained in the water must necessarily escape. The deeper water, being still under the greater pressure of the water above it, is less affected by this change of air pressure, and being colder than the surface water, in accordance with another accepted physical fact, further depletes the surface water of its air by absorption.

The recognition of this condition carries with it the realization of the fact that the fish must find greater difficulty in obtaining the necessary blood aeration while swimming in the water near the surface, and consequently they remain at the bottom of pool or stream until the conditions change, making only such incursions into the regions of discomfort as may be required in the quest of food, and only at such times as they will suffer the least discomfort.

There one finds himself as to fish!

Consider the human. An analagous condition affecting man is found in the highest altitudes under a decreasing air pressure, when the difficulties of respiration are increased as the air pressure is diminished, until finally the danger point is reached. In crossing the Continental Divide in the Rockies has one not wagered that he can run the length of the train and back to win a dinner he could not eat because he dropped in his tracks on completing a dogtrot wound up with an hundred-yard dash?

The strain on the heart which follows a marked decrease in the air pressure is so well known that persons suffering from any organic or functional disturbance of the heart are positively forbidden by their medical advisers to cross the Rocky Mountains, though in the comfortable seat of a Pullman no other exertion than that of breathing is required. The increased rapidity of the respiration calls for more rapid heart action, and that again for more respiration, until at last what is known as a "vicious circle," of which we have heard so much at Washington lately with reference to the H. C. of L., is established, and the weakened and overworked heart gives way.

The fisherman himself will most likely be conscious of the depressing influence of those days when the lighter and moister air seems to deprive him of his energy and diminish his desire to make active exertion.

Mr. INGHAM propounded his theory to fellow-campers and they scoffed at it. He told them there would be no fishing in those parts until his barometer indicated a return to normal atmospheric conditions, and forthwith packed off home. Three or four days afterward the air pressure became normal again, and our fisherman learned with satisfaction that the fishing was as good as it ever had been, both as to the weight and the number of fish taken. He is aware that a single observation is not sufficient firmly to establish such a theory upon, but he hopes that with publicity given the idea that the attention of those most interested will be focussed on the subject, so that further and conclusive proofs may be established.

So the proposition is:

Is a trout fisherman's success or failure in any way dependent upon the amount of air pressure, as indicated by the barometer?

If the INGHAM theory is correct, then a barometer will become a necessary part of every fisherman's outfit. If the answer turns out to be in the negative, something will have been learned, and perhaps from the close study of the conditions which the collection of this barometric data has necessitated, someone will evolve a theory which will stand all the tests and furnish a satisfactory solution of the problem.

COMPRESSED AIR MAGAZINE would totally lack in a sense of appreciation of a fine point that means much in our brief period on this puzzling sphere if it failed to urge that the INGHAM theory be tested by all thoughtful followers of the gentle ISAAK WALTON, so we spoof not while we spin it.

HONOR FOR FATHER OF DAYLIGHT SAVING OF 30 YEARS AGO

AGITATION for and against daylight saving recalls the first introduction of that character of legislation in the Congress three decades ago, when JOSEPH H. O'NEIL, a representative from the fourth congressional district of Boston, introduced his bill providing that the clocks of the nation be turned ahead fifteen minutes on each of the four Sundays in April, until the full hour had been reached. The process was then to be reversed by turning the hands back again fifteen minutes each Sunday in September until sun time had been restored.

This sensible plan to conserve daylight and save the nation millions of dollars at a time when it was not so prosperous as it is today, and also calculated scientifically to add to the American reservoir of health and energy, received scant courtesy or consideration from the other lawmakers of the time and was pigeon-holed. That his idea had merit, however, was demonstrated when European countries adopted it in the course of the Great War and when it finally became enacted into law in this country thirty years after its first introduction, though its repeal unfortunately has followed.

Farmers in some sections have protested against the measure and there have been facetious remarks by rural statesmen that the cows of their districts did not wear wrist watches. Less openly, but none-the-less strongly made, have been the protests voiced by agents for the light and power companies. The public as a whole, however, including manufacturers and other large business interests, have found daylight saving to their advantage, and sentiment, heeded by President WILSON, has been that the fullest enjoyment of "God's medicine," as an old college professor called it, was for the best interests of the largest number of people, in both health and morals, and in an economic sense. Mr. O'NEIL, of Massachusetts, seems fairly entitled to the belated recognition his name is receiving for his salutary plan.

A QUITE EXPECTED DEARTH OF ENGINEERS IN RUSSIA

THE TROUBLE with "Soviet Russia" is "a little knowledge" and too much KARL MARX. B. W. HUEBSCH of New York is publishing and sending forth press agent matter, either wittingly or unwittingly, for the unrecognized Soviet government, including innocent-looking engineering and industrial items. We find ARTHUR RANSOME'S "Russia in 1919," published by HUEBSCH, quoted from on "Turf Fuel for Power" and "Engineering in Russia." PAVLOVITCH, "President of the Committee on Public Works," asks that foreign engineers and technicians come to Russia, "because we are almost as short of skilled men as we are of locomotives—and of course they need not be Socialists, so long as they are good engineers." Possibly if the Bolsheviki had not slaughtered so many of their own countrymen of brains and accomplishments, merely because they did have a degree of intelligence superior to that of the savage brute, there would not now be such a dearth of needed technicians. The terrible fate of reputable men massacred in cold blood, whose only offense against the soviets was that they happened to be cultured, educated gentlemen, and perhaps men of means, will not start any hegira of engineers toward Russia at this time, no matter what propaganda of blandishment through RANSOME and others for the "President of the Supreme Council of Public Economy," continues to be inflicted upon us.

GIANT CUNARD BUILDING TO BE OUR NEXT-DOOR NEIGHBOR

IT IS A PLEASURE for us to note that COMPRESSED AIR MAGAZINE is to have as a next-door neighbor the new 21-story Cunard Building, which will occupy the large and highly valuable site bounded by Broadway, Greenwich and Morris streets and the Bowling Green building. The site is one of the most valuable pieces of real estate in the world and upon it is to be erected a notable structure in which will be housed the general American offices of the Cunard Line, occupying several stories.

Of unusual magnificence and size is to be Great Hall, in which will be quartered the passenger and freight offices of the Cunard. This lofty chamber, one of the largest for commercial purposes in the world, will be 65 feet in height, 185 feet long and 74 feet wide, and will exceed many large auditoriums in size. Mural paintings are projected to tell the story of the development of the steamship company since its early beginnings, and domes, bays and panels will otherwise relieve the lines of the walls of Great Hall.

The architects, BENJAMIN WISTAR MORRIS, and CARRERE & HASTINGS, associates, have provided plans for a structure with an exterior on classic lines with a leaning toward Italian Renaissance. The building will be fully worthy of the traditions of the line it will house and will be a credit to Bowling Green and to the Custom House section near the Battery, with which latter it will be almost within stone's throw, while facing the former historic spot of New York's early Dutch days.

As we write the noted old Stevens House at Morris Street and Broadway is half razed and will soon be a structure of memory only. Next will be heard the sound of the rock air drill, without which no foundation can be built for a Manhattan skyscraper and later will come the staccato of the air riveter on the steel frame, also indispensable in metropolitan building construction. Completion of the Cunard Building will fill out the last remaining available site in lower Broadway below Fulton Street that is not already occupied by a comparatively modern building of earning capacity.

New Berth for W. H. Woody

The Keller Pneumatic Tool Company of Grand Haven, Mich., has opened a division office in the Munsey building, Washington, D. C., to which Mr. W. H. Woody has been assigned as division manager. Mr. Woody was formerly connected with the New York office of the Chicago Pneumatic Tool Co. and later was in that company's southeastern territory. Subsequently he was for a number of years master shipfitter of the hull construction department of the United States Navy Yard at Norfolk, resigning his place there to go with the Keller company recently.

Books and Writers

EFFICIENT RAILWAY OPERATION, by Henry S. Haines, A. S. C. E., A. S. M. E., formerly vice president and general manager of the "Plant System" of railway and steamship lines, Commissioner Southern States Freight Association, one-time President American Railway Association. With tables, charts and statistics. Price, $4 net. New York: The MacMillan Company.

WRITING FROM intimate personal knowledge and experience, our author's working result is an expert book—by an expert. For many years, Colonel Haines was the administrative and operative head of one of the largest railway (and steamship) systems of the country, as well as president of the American Railway Association, so he knows his subject. He traces in his newest work the growth of the railroad from its beginning and especially its development in the United States, clearly defining the principles of efficiency in the department of motive power, rolling stock, roadway, traffic and operation. He has also added a most interesting chapter on what may be called railway strategy in time of war.

The volume contains much up-to-date information of a special character obtained from prominent railway officials and reports of the International Railway Conference. The work is devoted to operation, as distinguished from administration. It deals with facts, not opinions; therefore it does not discuss matters of finance, rates or labor questions. We wish it did discuss the present brotherhood proposals.

In describing the progressive development of efficiency in operation of railways in the United States, as compared with similar progress in other countries, by suggestion of many persons who had inquired for authoritative information for the use of students and junior railway employees, the author has added in appendices, very complete tables of statistics and much strictly technical information, drawn from official sources. The book is a distinctly valuable addition to modern railway literature.

His description of airbrake control of long trains is of value and of high interest and marks the developments in braking efficiency.

PRINCIPLES OF FOREIGN TRADE, by Norbert Savay, M. A., LL.B., sometime special lecturer on foreign trade, Notre Dame University, and formerly counsel of the Russian Consulate General. With appendix and index. Price, cloth, $4 net. New York: The Ronald Press Company.

THE PRIMARY aim of this book, as outlined by its author, is to set forth those general principles which underlie the building up of foreign trade, not merely of such trade as is a convenient outlet for a few superfluous home products, but as a part of a permanent and national foreign trade policy. It is not a "how book" but nevertheless practical details are not entirely omitted.

It is a brand new manual, issued this summer, and covers practically every aspect of foreign trade. It embraces all the technicalities of the subject and blocks out its economic, marketing, legal, shipping, banking, and advertising and selling principles. Dr. Savay tells how to obtain preliminary information on foreign markets, how to conduct investigations on the ground, tells of sources of private and public information both here and abroad, gives suggestions on the training of salesmen for foreign fields, shows how the foreign trader trains his own men, and gives facts on foreign trade customs and policies.

The commercial laws the exporter should know are summarized, as are various methods in use both in America and foreign countries in the financing of shipments. The volume is equally designed for the manufacturer and merchant already engaged in foreign trade and for the business man who seeks a complete knowledge of its possibilities. Here is a timely and competent volume by a man who writes from knowledge and who employs good business logic and practice. The book fills a gap in expert literature and should enjoy a large sale.

ESSENTIALS OF ALTERNATING CURRENTS, by W. H. Timbie, Editor-in-Chief of the War Department Committee on Education and Special Training, Vocational Instruction, and H. H. Higbie, Professor of Electrical Engineering, University of Michigan. First edition, first thousand, viii+374 pages, 5x7. Illustrated with drawings and photographs. Price, cloth, $1.60 net. New York: Messrs. John Wiley & Sons, Inc. London: Messrs. Chapman & Hall, Limited.

THE HOUSE of Wiley has turned out a new book in its technical series under the editorship of Joseph M. Jameson, on the subject of alternating currents, an inexpensive work that will be highly serviceable to the electrical engineering student. Answers to problems in the book are published in separate form in paper binding at a nominal price of 25 cents.

Some of the chapter headings will indicate the value of the work:

Modern Systems of Power Transmission. Transformers. Fundamental Ideas. Impedance. Power and Power Factor. Current and Voltage Relations in Series and in Parallel Circuits. Relation Between Impedance, Resistance and Reactance. Polyphase Circuits. Calculation of Wire Sizes for Various Distributing Systems. Motors, Starters and Controllers. Converters and Rectifiers. Appendix.

Desirable qualities of this book are:

It deals only with the information and problems of alternating-current practice which an electrical worker is most likely to meet in his trade.

It is written in simple language, the method of presentation adopted being such as to enable grammar school graduates to grasp and retain the fundamental information.

It avoids the use of algebra and trigonometry.

It is the result of several years of experience in teaching alternating-current electricity in short intensive trade courses for electric wiremen.

The book is handily indexed and is one that may safely be commended to the student and engineer.

OUR FIRST AIRWAYS, THEIR ORGANIZATION, EQUIPMENT AND FINANCE, by Claude Grahame-White and Harry Harper. With eleven special illustrations by Geoffrey Watson. Price, $1.50 net. London: John Lane. New York: John Lane Company.

IN AN EDITORIAL in the August issue, we called attention to the developments in England in aerial navigation, the establishment of airways and the pioneer work being done by Britishers. Much of what was published in that editorial, entitled, "The Age of Air Begun in both Europe and America," is confirmed in the book by Messrs. Grahame-White and Harper.

Our First Airways is a very business-like and practical little volume that our new American Air Ministry (when we get one) will do well to peruse with care.

Though vague generalizations have already appeared in print—the writers relying mainly on their imaginations—there has been no book as yet, nor indeed, any authoritative piece of writing, which tells a reader in definite terms how this new traffic of the air will be organized and operated for carrying mails and passengers. Mr. Grahame-White, in his capacity of managing director of the Grahame-White Company, has been called upon to review this whole question from the very practical point of view of a contractor to the Post Office (London) for the carriage of mails by air; while Mr. Harper has been acting as technical secretary of the Civil Aerial Transport Committee (London). They are, therefore, fully competent to impart information on this subject.

The book will appeal to the thousands of educated men in air service, many of whom have remained in aeronautics since the war; to practically the whole of the higher-class workers in the large aircraft industry; to the general reading public to whom airway work will open up rapid means of travel.

THE A-B-C OF AVIATION, by Capt. Victor W. Page, Sig. R. C., A. S. Illustrated with drawings, charts and photographs. Price, $2.50 net. New York: The Norman W. Henley Publishing Co.

THIS BOOK has recently come to our attention for the first time and we have found it worthy of careful inspection. It is a complete, practical treatise outlying clearly the elements of aeronautical engineering, with special reference to simplified explanations of the theory of flight, aerodynamics and basic principles underlying the action of balloons and airplanes of all types, and at the same time is a non-technical manual for all students of aircraft.

The author indicates that the work is not intended to be an engineering treatise, nor is it intended to consider technical points that can interest only the designer. Every effort has been made to explain all difficult points and numerous diagrams have been prepared to amplify the text. The book is well adapted for instruction work on general principles of mechanical flight and their practical application in both lighter-than-air craft and airplanes. It will be found, too, as well suited to home study work as to classroom instruction.

Compressed Air at Carnegie Tech.

To the Editors of COMPRESSED AIR MAGAZINE:—With reference to your recent publications on the subject of education in compressed air practice and your letter to President Hamerschlag of the Carnegie Institute, which was referred to me for reply, permit me to state:

The subject of pneumatic engineering is a very important one, but it is not broad enough to form the basis for a separate department in a technical school. And as long as it is scattered through mechanical engineering, mining and metallurgy, it does not receive the attention which it deserves. Recognizing this condition, I put into the course of mechanical engineering at Carnegie Tech, a course on pumps and compressors, which is studied by mechanical, mining and metallurgical students.

The Carnegie Institute is always willing to add options and courses, if there is a real demand for instruction. If we had any assurance that there would be ten to twelve students each year to follow the subject of pneumatic engineering, we would most certainly provide an option in that line of work. Manufacturers of pneumatic equipment could assist materially in furnishing the laboratory with pneumatic machinery and could furnish data and drawings for the use of students. But who is going to furnish assurance that there will be regularly that number of students?

In the department of mining engineering, the mine owners of Western Pennsylvania and of West Virginia have united to assure a regular supply of students for a special course in coal mining, which proves that a regular supply of students can be guaranteed, if somebody will take interest in the work.

If you are interested, I can give you a synopsis of our course in pumps and compressors.

W. TRINKS, *Professor.*
Carnegie Institute of Technology, Pittsburgh, Pa.

Buenos Aires

To George V. Hobart

At ten, a child, at twenty, wild;
At thirty, tame, if ever;
At forty, wise; at fifty, rich;
At sixty, good, or never!
Experience.

Mr. A. Flam is a dealer in skins in the late twenties, Manhattan, it would probably charm Franklin P. Adams of the *Tribune* "Conning Tower" to learn. We haven't encountered Mr. Flim anywhere on our travels; that is, not by name.

We wonder where some of our modern American slang originated. Ever hear of a poetical gentleman named Pope? It was he that penned the lines:

You beat your pate, and fancy wit will come—
Knock as you please, there's *nobody at home.*

In a not too distant future, may we hope and pray,
They will furbish all the kiosks of the old Subway.

Two lawyers, when their wrangled case was o'er
Shook hands, and were just as good friends as before.
"Say!" yelled the losing client, "how come you
To be such friends who were such foes just now?"
"Stupid!" one answered, "lawyers, though so keen,
Like shears, ne'er cut themselves, but what's between!"
The Client.

MAIN STREET JOTTINGS

GOTHAM, Sept. 1.—The Penn hotel up near the depot had some strangers for supper last Friday night. Some caitiff from Westchester county, or some other place out West, got away with the comb and brush from the washroom, it is rumored, and there is talk of putting chains on the new ones. The idea is to hook up the chains with the electric lights so that if anybody cuts them that there will be a short circuit leaving the miscreant in the dark and making it easy to capture him. The new equipment will probably be bought at Jim Bell's store next door to the hotel.

Town Constable Enright has been busy of late with his deputies in ferreting out crimes and the like in these environs. One Rolls-Royce and a couple of Henry-Fords were taken right from in front of the Hickory Street garage the other evening while Slim Smilax and Hi Jenkins were to home getting supper. The very next day a motorcycle was stolen from in front of the Ee-light movie house. The worst of this was that the motorcycle belonged to our traffic department, which is Jack Cowslip, who was inside the movie getting pointers from Bill S. Hart. These here auto thieves have got to stop their dastardly depredations, is what our constable says, else he will have the law down on their heads or know the reason why.

News are pretty scarce at this writing, although ye cor. has tried graphic automatism like Jack Chaloner used, to bring the ideas seething forth, but all in vain. Maybe our Horn & Hardart automatism, which causes a callus on the right thumb, hinders our writing much. Jack, who has been on a visit here from Virginia, now that he can legally transact business in this vicinage, used to sit down with a pencil in his hand, according to Doc Wood, and the hand would write without his thinking of a thing in particular. We'll bet that's the way that reptile editor of the scorpion *Sentinel* gets a lot of his alleged news.
Vox Populi.

A friend of ours is going on his belated vacation and gosh, how he dreads it. His holiday is to be taken in these here now *sec* states.

If this plinth of perspicacity looks a bit lean this month it's because the contributors have been off fishin'.

BAWMIE INTHEBEAN.

FOURTEEN POINTS IN THE LEAGUE OF SUCCESS

*By BERT EDWARD BARNES**

MANHOOD which stands for strength in purpose and virility in action.

OPTIMISM, that which gives courage, sweetens toil and lightens the burdens.

RESOURCEFULNESS which conquers obstacles and attracts other men to you.

ENERGY, the powder of success which produces the miracles of enthusiasm.

ENTHUSIASM, the salt of life that renews and enriches everything it touches.

FRIENDSHIP, a beautiful and noble thing, which animates virtue and good resolutions.

FIDELITY which puts more than an expectation of pay into one's work.

INTEGRITY, an indispensable virtue, the cornerstone of most successes.

CHARACTER, one of life's most precious things, cherished by all.

INITIATIVE, the essence of character and the basis of most big achievements.

ENDURANCE, a better test of character than any one act of heroism, however noble.

NOBILITY, that which carries sunshine and good cheer to the poor and suffering.

CHEERFULNESS, a public duty, irrelevant to any religious creed or doctrine.

YOUTHFULNESS of spirit which has its fruitage in the preservation of health.

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*Editor *Morse Dry Dock Dial*

CONFIDENTIAL EMPLOYMENT BUREAU

NOTE—Advertisements under either of the classifications below will be numbered in the order of receipt and published free of charge, for the benefit of readers, in the next issue after date. All applications for the use of this convenience should be directed, "Confidential Employment Bureau," Compressed Air Magazine, Bowling Green Building, New York City. Replies to advertisements will be forwarded to the person or persons concerned.

HELP WANTED.

No. 429—Coal Mining Engineer of experience with a prominent company. Exceptional opportunity for man of ability who is willing to work and makes good. Give references, state previous experience, salary, etc. Confidential.

No. 430—Wanted a Coal Mine Foreman for large electrically equipped mine. Location, Pennsylvania. Married man preferred. Give full information as to salary, references, etc.

No. 431—Wanted by manufacturer of machine tools, an assistant superintendent of shop. Must possess thorough knowledge of modern foundry and shop practice. Give full information. Position and location will appeal to an A-1 man.

No. 432—Draftsman wanted, experienced in die, jig and fixture designing for work in automobile manufacturing plant, located in Ohio. Good future, pleasant location. Describe self and experience fully. State salary.

POSITIONS WANTED.

No. 854—Production Manager, with 10 years shop and foundry experience, capable of taking entire charge of plant, desires to make connection with a growing business in the middle west. At present employed. Best of references as to character and qualifications.

No. 855—Metallurgical Engineer of experience will be open for position on October 1st. At present employed on temporary work. Thoroughly experienced in test treatment of metals and competent to take complete charge of chemical, physical and metallographic laboratory. Interested only in first class position.

No. 856—Graduate Civil Engineer, four years general experience on roads and concrete and steel structures, drawing room and field, wants position with a company in the west. Must be opportunity for advancement. Married and can give best of references.

No. 857—Position wanted by Mining Engineer as general mine superintendent. Age 39, married. Have had 10 years practical experience, 5 of which were with large gold mining company in the west. Seeking change for greater opportunity.

No. 858—Married man of 36, of good habits and record seeks change of position. Experienced in installing and operating gas engines, electrical machinery and compressors. Has also had machine shop experience, mechanical drafting and office work. Understands concrete forms and foundation work and can handle men and materials with good results.

No. 859—Young Scotch mining engineer writes from Scotland expressing his desire to obtain a position in the U. S. A. with either a coal or a metal mining company. Has had thorough schooling, is well up in the use of transit and can supply excellent references.

No. 860—Underground operating engineer, acting as mine superintendent, having sixteen years' experience in mining and familiar with construction work, seeks a place in Arizona or Far West. American born. Thoroughly familiar mining machinery and methods. Ample references. Salary $200 monthly to start.

WESTINGHOUSE HOUSING PLANS

Housing facilities which at present are inadequate at Wilmerding, Pennsylvania, the home of the Westinghouse Air Brake Company's Works are to be extended at once by the erection of a number of new dwellings for the families of the employees.

The Westinghouse Air Brake Home Building Company has been formed with a capital of $1,000,000 for the purpose of transacting all business relative to the real estate and dwellings which have been transferred by deed to this company by the Westinghouse Air Brake Company. It includes the ownership of over 400 houses and considerable vacant property in the borough of Wilmerding and the adjacent territory.

Since the Westinghouse Air Brake Company built its first houses for employees in 1890 there has never been an increase in rents and the new company will carry out the same policy.

A director of the Marconi Co. states that experiments on a new type of wireless telephone are so far advanced that it will shortly be possible to speak between London and New York, while the establishment of a regular commercial service by wireless telephone between London and New York early next year is expected.

Latest U. S. Patents

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

JULY 8.

1,308,811. PERCUSSION-DRILL. Lewis L. Scott, St. Louis, Mo.

1,308,848. VACUUM FUEL-FEED DEVICE. Webb Jay, Chicago, Ill.

1,308,850. MOUNTING FOR FLUID-PRESSURE SYSTEMS. Everett P. Larsh, Dayton, Ohio.

1,308,904. METHOD OF AERATING LIQUESCENT MATERIAL AND MACHINE FOR THE PURPOSE. Mark Hopkins and Charles Brunkhurst, Middletown, N. Y.

1,308,929. METHOD OF AND APPARATUS FOR SULFUR-MINING. Robert E. Carmichael, Damon, Tex.

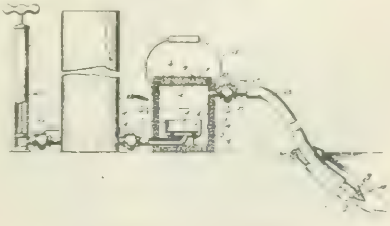
1,308,930. HUMIDITY AND TEMPERATURE REGULATOR AND THE LIKE. Willis H. Carrier, Buffalo, N. Y.

1,308,961. DUST-COLLECTOR. Jeffrey J. Power, Madison, Wis.

1,308,982. FAN-BLOWER. Frans H. C. Coppus, Worcester, Mass.

1,309,166. GLASS-BLOWER. Edward O. Whitley and Edward L. Knowlton, Williamstown, W. Va.

1,309,193. RODENT-EXTERMINATOR. Jacob T. Garrison, Oakland, Calif.



PATENT NO. 1.309.193

A rodent exterminator comprising a combustion chamber including a metal outer wall, a sheet asbestos inner wall and a filling of insulating material therebetween, a fire pot within the chamber, a reservoir exterior to the chamber and having a valve controlled pipe leading to the fire pot, means for supplying air under pressure to the reservoir, a flexible pipe connected with the combustion chamber and a nozzle at the free end of the flexible pipe.

1,309,229. PUMPING SYSTEM. Frederick C. Weber, New York, N. Y.

1,309,282. MULTISTAGE CENTRIFUGAL FAN AND PUMP. William Johnston Frame, London, England.

1,309,321. AIR-GUN. Frederick Humbert Fairweather, Bridgeport, Conn.

1,309,457. MILKING-MACHINE. John S. Buckwalter, Lancaster, Pa.

1,309,465. METHOD OF BLOWING DOWN AND BLOWING OUT BLAST-FURNACES. John W. Dougherty, Beaver, Pa.

1. The method of blowing down and blowing out blast furnaces, comprising forming and maintaining within the furnace a non-explosive gaseous mixture at about when the blast is turned off.

1,309,517. TIRE-PRESSURE INDICATOR. Benjamin G. Gilbough, Los Angeles, Calif.

1,309,528. AIR-PUMP. George Klundt, Streeter, N. D.

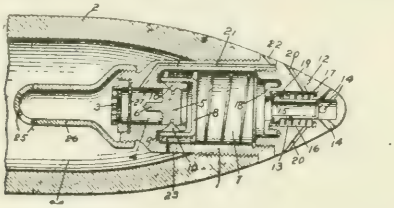
JULY 15.

1,309,649. PERCUSSIVE ENGINE. Wilhelm Mauss, Johannesburg, Transvaal, South Africa.

1,309,718. VACUUM-FEED FOR OIL-ENGINES. George C. Clark, Everett, Wash.

1,309,737. AIR WASHER AND HUMIDIFIER. Robert A. Ilg, Chicago, Ill.

1,309,773. PNEUMATICALLY - OPERATED IMPACT-FUSE. Edward W. Newell, Pittsburgh, Pa.



PATENT NO. 1,309,773.

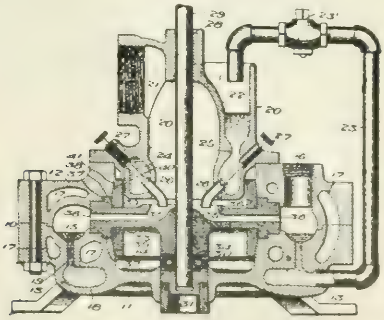
1. A projectile provided with a chamber and having inlet ports through which air from the atmosphere is compressed into said chamber by the flight of the projectile, a firing plunger for detonating the projectile, and means operated upon impact of the projectile for supplying fluid from said chamber to operate the firing plunger.

1,309,786-7-8. FLUID-PRESSURE BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,309,825. AIR-CUSHION FOR STEAM-NIGGERS. William Henry Trout, Milwaukee, Wis.

1,309,879. VACUUM AIR-SEPARATOR. Ernest M. Davids, Tropico, and Lycurgus Lindsay, Los Angeles, Calif.

1,309,880. AIR-CHARGING DEVICE. Frank C. Dorment, Detroit, Mich., assignor of one-half to George J. Lowe, Cleveland, Ohio.



PATENT NO. 1,310,116.

1,309,923. PNEUMATIC SCRAPER FOR CLEANING FISH. Edward H. Waugh, Seattle, Wash.

1,309,942. GLASS-DRAWING APPARATUS. Halbert K. Hitchcock, Pittsburgh, Pa.

1,309,943. APPARATUS FOR PUMPING FLUID. Herbert Alfred Humphrey, London, and William Joseph Rusdell, Wolverhampton, England.

1,309,977. AIR-HEATING APPARATUS. Henry Baetz, St. Louis, Mo.

1,310,099-101. BLOWPIPE. George L. Walker, New York, N. Y.

1,310,116. CENTRIFUGAL PUMP FOR COMPRESSION AND VACUUM. Edward C. D'Yarmett, Muskogee, Okla.

1,310,152. LIQUID-FUEL FURNACE. William M. Burdon and Matthew M. Burdon, Bellshill, Scotland.

1. A method of burning heavy oils for heating purposes in which air is heated to a temperature above the flash point of the oil and is then caused to gyrate and while in a state of gyration is caused to atomize and vaporize oil delivered to the interior of a hollow member through which and also outside of which the gyrating air passes, whereby the oil in a finely divided state will be disposed between an inner and outer stream of air.

1,310,393. VACUUM FEED MECHANISM. Floyd Garwick, Chicago, Ill.

1,310,332. TIRE-PUMP FOR AUTOMOBILES. Joseph Marie Etienne Franc, St. Vallier, France.

JULY 22.

1,310,455. METHOD OF ROASTING ORES OR CONCENTRATES. Urlyn C. Tainton, Doornfontein, Johannesburg, Transvaal, South Africa.

1,310,471. AIR-COMPRESSOR. John C. Fredericksen, Miller, Ind.

1,310,672. COOLING AND INSULATING SYSTEM FOR TURBO-COMPRESSORS. Earl H. Sherbondy, Cleveland, Ohio.

1,310,682. DUPLEX TURBO-COMPRESSOR. Earl H. Sherbondy, Cleveland, Ohio.

1,310,745. AIR-GUN. Albin R. Falk, Moline, Ill.

1,310,815. DUSTING-MACHINE. Bent L. Weaver, Harrisburg, Pa.

1,310,876. AIR-PUMP. Paris L. Savage and Herbert E. Morton, Bisbee, Ariz.

1,310,944. AIR-COMPRESSOR. George K. Davol, San Francisco, Calif.

1,311,023. AUTOMATIC AIR-HOSE COUPLING. Wallace H. Stone, Wabasha, Minn.

JULY 29.

1,311,161. BLACKING-MACHINE. Frederick M. Furber, Revere, Mass.

1,311,235. METHOD OF AND APPARATUS FOR PRODUCING BLASTS OF HEATED AIR. William Wallace Kemp and William H. Van Horn, Baltimore, Md.

1,311,249. METHOD OF AND APPARATUS FOR GATHERING GLASS BY SUCTION. Emile Roirant, St. Ouen, France.

1,311,328. AUTOMATIC VALVE FOR CONTROLLING THE FLOW OF GASEOUS MIXTURES. Henry S. Dodd, Toronto, Ontario, Canada.

1,311,358. PNEUMATIC SEPARATOR. Harold M. Plaisted, St. Louis, Mo.

1,311,533. COMPENSATING PUMP FOR PNEUMATIC VEHICLE-TIRES. Harry C. Schroeder, Berkeley, Calif.

1,311,594. PROCESS OF AND APPARATUS FOR OBTAINING OXIDS OF NITROGEN FROM ATMOSPHERIC AIR. Francis I. DuPont, Wilmington, Del.

1,311,617. PNEUMATIC-DESPATCH-TUBE APPARATUS. Albert W. Pearsall, Lowell, Mass.

1,311,647. CARRIER-DESPATCH APPARATUS. Charles P. Hidden, Brookline, Mass.

1,311,693. AUTOMOBILE-TIRE PUMP. George Edgar Hazard, Rochester, N. Y.

1,311,738. METHOD OF MAKING PUNCTURE-PROOF TIRE-TUBES. George F. Armstrong, Rutherford, N. J.

1,311,760. MEANS FOR AND METHOD OF APPLYING COATING. Harry O. Davis, Ipswich, Mass.

1,311,806. SECTIONAL PNEUMATIC TIRE. Henry B. Coats, Veedersburg, Ind.

1,311,815. BLOWPIPE-BURNER. John Harris, Cleveland, Ohio.

1,311,839. PNEUMATIC COATING APPARATUS. Jens A. Paasche, Chicago, Ill.

COMPRESSED AIR MAGAZINE

Vol. XXIV NOVEMBER, 1919 No. XI

Telescope Pneumatic Caissons

THE pneumatic caisson is now a most familiar device and practically indispensable for the foundations of the heavy buildings continually being erected in the downtown section of New York City. Of what may be called the regular type of pneumatic caisson there remains little to be told as to its construction or the manipulations connected with its installation. The caissons here to be spoken of, however, were designed to be placed under peculiarly restricting conditions and constitute an interesting novelty in engineering. For the description of the design and construction of those caissons and the method of their emplacement we are indebted to Mr. Frank H. Eastman, Foundation Engineer, New York City, whose narrative is reproduced, some liberties being taken with the text, from *Engineering News-Record*. Many incidental items of information are found in the course of the narrative.

These telescopic compressed air caissons were used, it need not be said with complete success, to make the foundation for a large vault in the basement of the Central Union Trust Co.'s building, 80 Broadway, New York, during the recent remodeling of the bank. Four new vaults were included in the work, the largest of which, 24x27x20 ft., weighing 275 tons, was so heavy a load that it was desired to found it on hardpan or bedrock as assurance against settlement. Construction had to be carried on in the low headroom and restricted space of the basement, however, and bank operations could not be interfered with; these facts and the danger of disturbing the footings of nearby building columns made the operation delicate and difficult. The William Young Co., contractor, New York City, carried out the work, its consulting engineer on the foundation being T. Kennard Thomson, who designed and constructed the foundation and proposed the use of the telescopic caissons.

Like many similar structures in lower New York, the Central Union Trust building rests on what has been termed a floating foundation, on the soil locally known as New York quicksand. This material has safely supported many fair-sized buildings and can be absolutely relied upon, provided it is not underdrained by subways or deeper excavation. The columns rest on brick piers supported on the quicksand only 1 ft. below the cellar floor. As the vault space would extend close to the footings of these piers on three sides and to the foundations of an existing vault on the fourth side, the sinking of deep foundations presented grave difficulties. Mr. Thomson planned to use a compressed-air system of shaft-sinking which he had used in 1909 for underpinning the Cambridge Building and had patented. In this system the top section of the shaft, constructed in the open, is capped with an air lock, and the shaft below is constructed by excavating in short sections and setting lining plates. This system was chosen for the vault foundations on the assumption that the excavation would be 30 ft. deep. On making borings, however, it was found that the piers would have to go down 45 ft., and Mr. Thomson therefore decided to adopt a modification of his plan patented by the late Ogden Merrill of the firm of Merrill-Ruckgaber Co., which was used by that firm at the New York Assay Office in 1909.

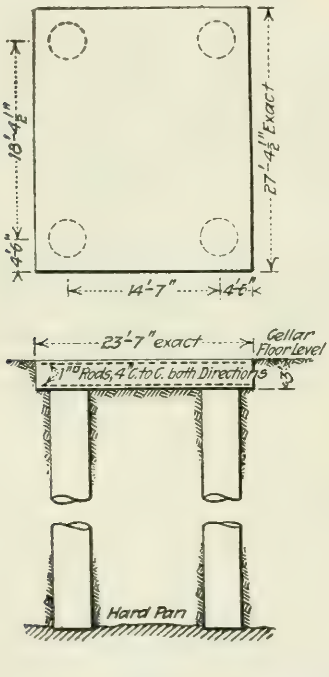
In this method the caisson sections are telescoped, and the sections below the upper or air-lock section are sunk successively by jacking down against the upper section. The method is more expensive than the Thomson shaft method, but avoids the necessity of excavating below the cutting edge to insert the lining segments.

DIGGING BELOW THE CUTTING EDGE

The quicksand of lower New York can nearly always be excavated a foot or two below the cutting edge without blowout. Thus, in a recent caisson foundation which the writer inspected, the cutting edge was stopped 2 ft. above hardpan and then 6 or 7 ft. of hardpan was removed without accident. This is probably the only time such a risk has been taken, and in the writer's opinion it should not be repeated. Excavating below the cutting edge in fine sand and clay and leaving a large excavation open for a day or two is a very different matter from excavating under a 4-ft. shaft for a few minutes while a lining plate is being set.

THE GROUNDWATER LEVEL

At the Central Union Trust Co. Building the final borings indicated rock or hardpan 62 ft. below street curb and about 45 ft. below cellar floor. Groundwater was found 8 ft. below the cellar floor. It was decided to build the four caissons of eight sections each, the bottom or smallest one being 4 ft. in diameter and 5 ft. 4 in. high (see sketch). The bottom ends of all sections were at the same level when the caisson was fully telescoped.



From the drawing it will be seen that inside the bottom of each section was riveted a band of 3x½-in. steel plate with the top edge beveled backward, adapted to engage the beveled edge of a steel angle riveted around the top of the next inner section. Thus, when any section was forced down to its final position, the steel angle at its upper edge would catch on the steel rim plate at the bottom of the next outer section, thus preventing the sections from pulling apart.

Four diaphragms were built for each caisson, for the sake of stiffness and to afford frames for doors, using the cylinders themselves as air locks. When construction work started, however, it was found that 20-ft. headroom could be used, and, as a Mattson air lock was available that could be worked in this space, the diaphragm and doors inside the caissons were not used. This air lock was 4 ft. in diameter by 10 ft. high and had the outside door on the side of the lock.

The specifications called for the caisson sections to be calked against air pressure, but, as a matter of fact, it was necessary to use considerable putty and oakum to make them hold air; and, as this would not hold back water pressure from the outside, all the concreting was done under air pressure. Each section was 2 in. less in diameter than the one above it, so that, as the shell plates were $^{5}/_{16}$ in. and the edging bands ½ in. thick, the theoretical clearance was $^{3}{}_{1}/_{6}$ in. on each side, or a total of ⅜ in. For similar riveted work (the sections were butt-riveted) the clearance seems ample, while with welded sections less clearance would be needed.

Each caisson was set in a 6-ft. excavation made to receive it, so that the top was slightly below the cellar floor line. Then a trench about 3 ft. wide and deep was made all around and filled with concrete, to hold the caisson down against the air pressure. Four timber struts were set between the top of the caisson and the floor above, as extra safeguards.

JACKS FORCE DOWN CAISSON SECTIONS

Sinking was done by forcing the caisson sections down by jacks. The whole group of sections inside the first or outer one was shoved down by four 7-ton jacks (4 in. in diameter by 22 in. high) placed between the top of the second section and the inside of the roof of the outer section; until the nest was down far enough to give room for inserting these jacks they were placed between pairs of beams attached to the lower nest and to the air-lock shaft. When sinking had progressed to the point where the angle at the top of the second section came to bearing on the band at the foot of the outer section, four 6x6-in. oak struts were inserted to hold down the second section during the subsequent jacking. This process was repeated for the successive stages of sinking until the last section was down and the shaft bottomed in the hardpan.

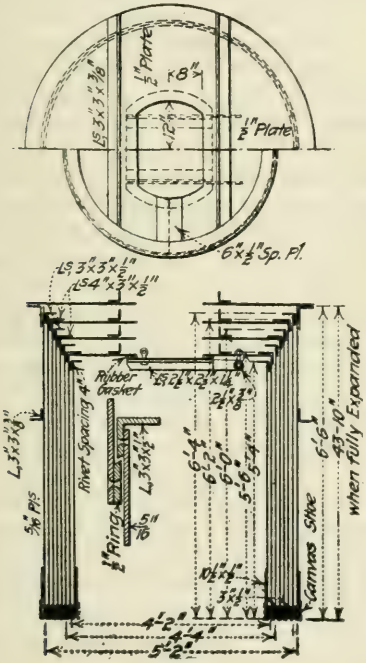
When the first two caissons were delivered on the job, two 800-cu.ft. compressors were set up over the locations of the third and fourth caissons, with an air receiver over them. When the first two cylinders had been sunk and concreted, the compressors were moved to a position over them, permitting the third and fourth caissons to be sunk without going outside the space occupied by the vaults.

The compressors and the first two caissons arrived on the site Feb. 17, 1919, and air was put on Feb. 22. Eight men were worked in each shift.

Five working days of three eight-hour shifts each were required to complete one caisson shaft. The fourth caisson was completed Mar. 28, and the concrete vault-floor slab, 24x27 ft. by 2 ft. thick, was completed April 9.

OPERATIONS KEPT QUIET

Excavation spoil was placed in tin pails, hoisted to the lock on top of the caisson and dumped; it was then put in canvas bags and carried out of the building at night. Concrete materials were brought in in the same way. Mixing was done by hand.



The first two caissons gave more or less trouble from jamming,, making it quite difficult for the jacks to force the lower sections down. The last two caissons, however, though presumably the same as the first two in every respect, worked very freely, never requiring anything like the full strength of the jacks.

As each section went down, oakum and putty were used to seal all joints. This was found to be a cheap and effective material for sealing. These precautions were vital, for escape of compressed air or the entrance of material from the outside into the working chamber might have endangered the stability of the bank building.

GROUNDWATER TAKES A JUMP

The entire operation was carried on without the slightset accident and without any damage to the building. There was, however, an interesting occurrence during the sinking of the first caisson. The groundwater level suddenly rose about 9 ft. However, the water suddenly dropped back 10 ft. and gave no further trouble. No explanation of the peculiar occurrence was ever obtained. A leak in a water main or an extra high tide and wind might have been responsible. Needless to say, if such changes in the water level occur periodically the foundations of buildings now resting on quicksand may in time be seriously endangered.

The entire work of reconstruction in the Central Union Trust Co. Building was under the supervision of A. A. MacDonald, of the William Young Co., the contractor, and Frank H. Eastman was superintendent in charge for the company for the caisson foundation.

FOR MORE MACHINERY IN QUARRY WORK

There is no doubt that the cost of stone can be lowered without any depression in wages, by a wider use of machinery, says Oliver Bowles of the U. S. Geological Survey, which would seem to be a most authoritative boost for compressed air and what the air implies.

Already America is far in advance of European countries in the use of machinery in stone working, and as a consequence the cost per cubic foot of Indiana limestone averages less than that of the English Portland stone (the two stones being similar), although wages paid in the Indiana district are about twice as high as in England.

The wide use of Indiana stone is largely due to economical methods of handling it, and a wider use of other types of stone could be brought about similarly by introducing more machinery into quarries and shops. The stone worker has, therefore, nothing to fear from the wide use of mechanical equipment, for it demands more skilled workers at higher wages, and the reduction in cost that results from the use of such equipment broadens the market, with consequent increased activity in the stone industries.

It is evident, says Mr. Bowles, that there is no more fruitful field for improvement in conditions in the stone industry than that of highly developed mechanical equipment.

Air Lift Pumping

THE following interesting, informing and suggestive notes upon air-life pumping are by Mr. John Oliphant, Manager of the Air-Lift Pumping Department of the Sullivan Machinery Company, Chicago, and are here reproduced from the *Canadian Engineer*.

While I am not going to enter at this time into the principles of air-lift pumping, I would like to call your attention to the advisability of a perfect emulsion of air and water at the footpiece in order to secure the best economy, and also to lay stress upon the care with which should be calculated the diameters of the water and air pipes for different lifts and different submergences.

While it is a fact that there are several types of mechanical deep-well pumps that up to certain depths will give theoretically a higher efficiency than air-lift, yet this difference in efficiency is theoretical rather than practical. It has been demonstrated time and again that air lift, even with its lower theoretical overall power efficiency, but with immunity from derangement, has been placed ahead of the deep-well pumps under many conditions of operation.

The village of Maywood, a suburb of Chicago, has a compressor handling a single well, pumping at the rate of 700 gallons per minute, with a lift of over 300 ft. This compressor has been operating for four years, twenty-four hours per day, with a stoppage of only a few minutes during the twenty-four hours for necessary examination and adjustments. This plant has been operated at the above capacity continuously at absolutely no cost for repairs and no shut-downs, except those above indicated. I believe this would compare favourably with the operation of a mechanical deep-well pump even at its higher rated efficiency.

There are a great many occasions where the air lift can be used as an auxiliary to a high-duty suction plant pumping from deep wells. Such a case came up over a year ago at Clinton, Ill., where they secure their water by suction from deep wells, and for ordinary purposes secure a sufficient amount by this method. But in case of peak loads in the summer and in case of fire, it was found that the supply secured by suction was not sufficient to cover their requirements.

The supply is secured from some half-dozen wells, having a surface flow of limited volume. These are connected so as to flow into a surface reservoir, or may be direct connected to mains by means of suction pumps. Experience showed that when suction was resorted to, the supply for the summer hot weather load, or for an extended fire demand, was insufficient. Three of the wells were therefore connected with an air-lift system arranged to discharge into the reservoir, using the suction piping as a gravity flow line. A suitable arrangement of valves is provided to permit this flow from the wells to the reservoir, while the service pumps draw their supply from the reservoir by suction. By this arrangement, the water supply was more than doubled from these three wells. One of the 8 in. wells had a natural artesian flow of about 150 gallons per minute. When under suction from the pumps, the pull-down was 20 ft., increasing the flow to 500 gallons per minute. When this well was connected up for operation under the air lift, its production was increased to 1,035 gallons per minute, the pumping head being 50 ft. below the surface. The other two wells connected up in the same manner showed a proportionate increase. These wells are handled by means of an air-lift pump suspended on a 2 in. air line in the 8 in. casing. The air for operating the wells is supplied by a straight-line simple steam and compound air compressor, size 14 in. by 16 in. and 10 in. by 16 in., having a capacity of 558 cubic feet of free air per minute. The installation was effected in a simple and economical manner, piping the air from the receiver to and into the wells. On ordinary service the pumps secure sufficient supply by direct suction. When an increase is demanded by the summer domestic requirements or by fire, it is merely necessary to start the compressor, throw open a few valves, and the supply from the wells is more than doubled.

For general information I include below some figures secured from two installations made at Galesburg, Ill. The first of these has been in operation over a year, and the second about six months. These plants are located at different points in the town and centrifugal pumps used to take the water from the service reservoirs and force it directly into the mains. You will notice that the efficiency indicated in these reports is the electric input to the motor, as compared to foot-pounds of work done, and includes all motor, transmission and compressor losses, and we believe will compare favourably with the highest type of mechanical pump under the severe lifts obtaining at these installations. The city of Galesburg has had considerable difficulty in securing sufficient water for the public supply. A number of wells in the neighborhood of the old pumping plants have been driven and equipped with various devices, but failed to give the amount of water needed. The old plant consists of three deep and six shallow wells, with a combined yield of about 250 gallons per minute, and has been very expensive to operate and maintain, and it was therefore determined to sink a new well.

The construction of this well was as follows: 40 ft. of 24 in. heavy steel casing, 106 ft. of 20 in., 130 ft. of 16 in., and 350 ft. of 12 in. steel casing. The 12 in. is sealed in the rock. The hole was then drilled 12 in. in diameter to a depth of 1,085 ft. from the surface, then reduced to 10 in. and drilled down to 1,255 ft. through the St. Peter's sandstone formation. The well was then shot with two 200 lb. charges of 100 per cent. gelatin, covering the entire sand rock strata, and carefully cleaned out. Wrought iron 10 in. pipe was installed and sealed into the top of the 12 in. pipe, approximately 350 ft. from the surface of the ground. This extends to within 3 ft. of the top of the sandstone strata, hermetically sealing the well from all water in the strata above the St. Peter's sandstone. The analysis made from the water secured from the completed well was superior to that of all other wells in the territory, on account of the sealing off of the upper strata.

At the site of this well an air-lift plant was constructed for lifting the water from the well to a small surface reservoir. Thence the water is forced into the mains against 40 lb. pressure, by means of a centrifugal pump. The air-lift equipment consists of one angle-compound compressor, with 16 in. and 9¾ in. by 12 in. cylinders, arranged with short belt drive and unloading valve; one standard 5 in. foot piece, outside air line, and well-head with umbrella separator; one 42 in. by 8 ft. vertical steel air receiver; and one 100 horse-power motor. The following are the conditions of operation and the results of the test on the well:—Depth of well, 1,252 ft.; water pipe in well, 235 ft. of 5 in., 331 ft. of 6 in.; main air pipe in well, 235 ft. of 2 in., 331 ft. of 2½ in.

On account of the severe drop, an auxiliary starting device was installed at a depth of 481 ft. 8 in., to pump off the head and keep the starting pressure within the range of the compressor.

Static head, from ground	186 ft.
Drop	118 ft.
Elevation above surface	7 ft.
Total lift	311 ft.
Operating submergence	262 ft.
Percentage of submergence	45.8
Depth of pump in well	566 ft.
Operating pressure	121 lb.
Starting pressure with auxiliary	129 lb.
Gallons per minute pumped	450
Actual cubic feet free air used per min.	450
Revolutions of compressor	179
Water horse-power—that is, foot-pounds of work done	35.5
Operating horse-power	94
Efficiency, per cent.	37.5

The efficiency shown is considered excellent, and this result was made possible by careful proportioning of the sizes of air and water piping, proper location of the foot piece or pump in the well, and by the use of improved foot pieces, providing a continuous flow of water. In this design the air is discharged from the foot piece into the water in the well casing in a multitude of fine jets, creating a very thorough mixture or emulsion of air and water. This action secures the maximum efficiency, as the chance of slippage is reduced to the minimum.

The figures on the second plant, known as the Bradley Well No. 2, are as follows, and are taken from a test on March 8th, 1919:—Depth of well, 1,245 ft.; diameter, 360 ft. of 15 in., 250 ft. of 14¼ in., 635 ft. of 13½ in.; water pipe in well, 204 ft. of 8 in., 213 ft. of 7 in., 190 ft. of 6 in.; main air line, 600 ft. of 3 in.; auxiliary line, 500 ft. of 1½ in.

CONDITIONS OF OPERATION.

Static head from ground	190 ft.
Drop	157 ft.
Elevation above surface	7 ft.
Total lift	354 ft.
Operating submergence	253 ft.
Percentage of submergence	41.75
Depth of pump in well	600 ft.
Operating pressure	115 lb.
Shut-in pressure	110 lb.
Starting pressure with auxiliary	135 lb.
Gallons per minute pumped	650
Actual cubic feet free air used per min.	719
Displacement	883
Revolutions of compressor	214
Water horse-power—that is, foot-pounds of work done	58.2
Operating air horse-power	148
Efficiency of air compressor compared to work done, percentage	39.3
Estimated input efficiency, percentage	35.8
Estimated motor efficiency, percentage	91

Attention is called to the advantage of air-lift pumping in the case of wells, the waters from which, in order to make them suitable for domestic or other purposes, require treatment for the elimination of sulphates or carbonates of iron in solution, or other impurities which can be oxidised and precipitated by aeration and then removed by filtration. In this method of pumping the compressed air is forced into and commingled with the water at the bottom, or at least deep in the well, by means of a multiplicity of fine streams or jets, ensuring the most intimate mixture of the air and water, every particle of the water being permeated with air as it rises in the eduction pipe. Oxidation and precipitation of the iron solution thus takes place with the greatest possible rapidity, and it is then a simple matter to remove it by filtration. Waters containing carbonate of iron are especially susceptible to treatment in this manner, the pumping operation at the same time serving the purpose of freeing the dissolved iron, so that it may be removed by the filter without even intermediate sedimentation.

The treatment of waters containing sulphates of iron are more difficult, and the use of ample sedimentation tanks or basins ahead of the filter are advisable. In some cases aeration must be supplemented by the feeding of a very small quantity of lime into the water to accelerate sedimentation, but in any event the thorough aeration of the water in the pumping operation is a very important and vital adjunct to the purification process.

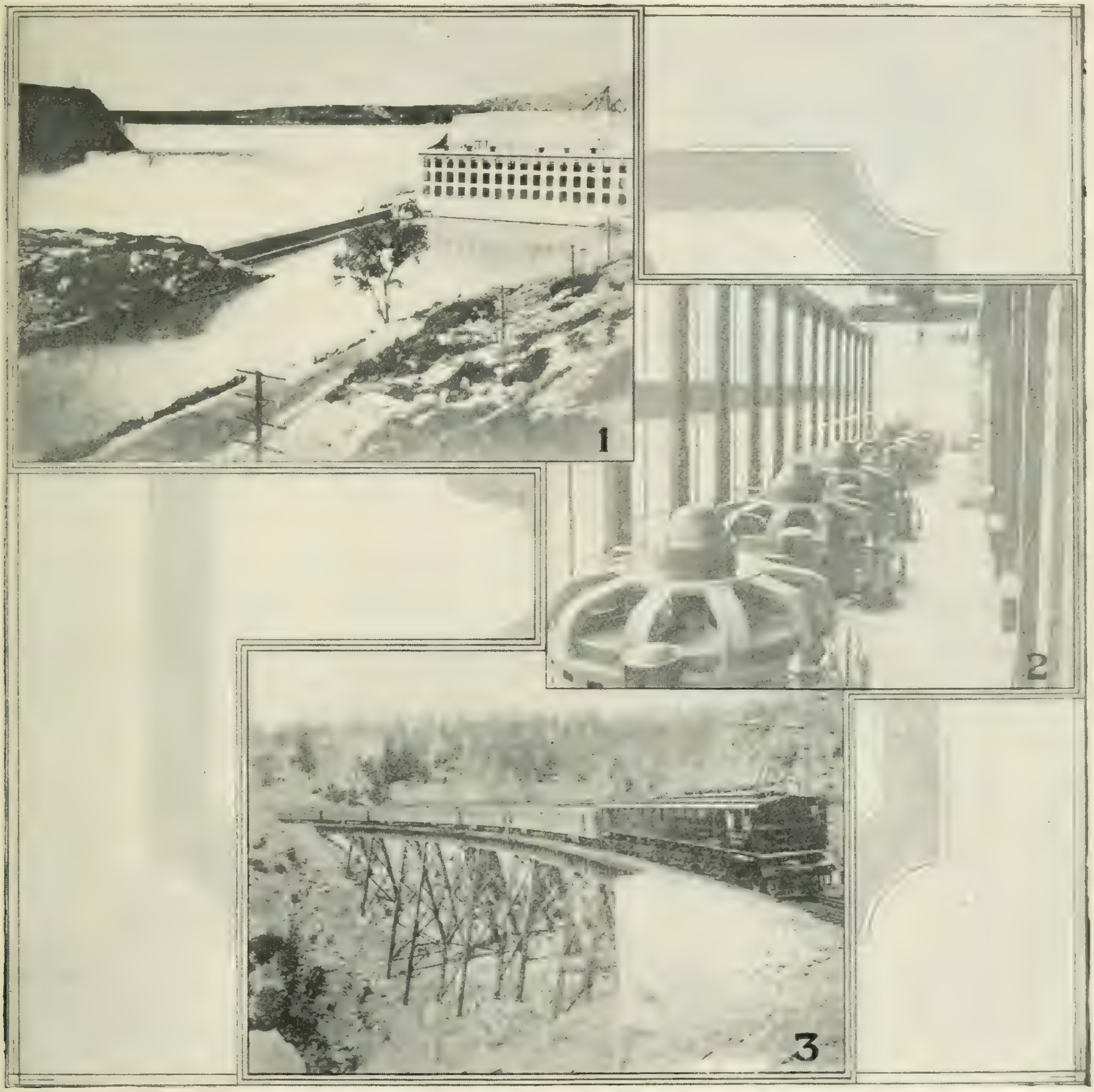
Combined air-lift pumping and purification plants can be arranged in many different ways, according to local conditions. In some cases the air-lift merely delivers the water to a sedimentation tank combined with a filter located at the surface, and as close to the well as practical, the effluent from the filter flowing by gravity to a surface reservoir or sump, whence it is forced by piston or centrifugal pumps into the service system, or to a service tank or reservoir located at a suitable elevation. In other cases, where the well or wells are deep enough to provide the necessary submergence, and others are right to utilize the air-lift—by means of an air-lift booster and re-lift jet—to lift and force the water in one operation from the wells to the elevated storage reservoir, this reservoir or tank also acts as a sedimentation tank, and the water can pass from it through a pressure filter into the service pipes. A third arrangement is where the pressure filter is placed in the line between the well and the elevated reservoir, and the water lifted and forced by the air-lift in one operation from the well through the filter and up to the elevated service reservoir.

I would like to call special attention to the two latter arrangements, as it is my observation that the possibilities of the air-lift, as a means of forcing the lifted water to a point beyond the well-top, are ont generally realized. While this method has its limitations, there are many situations where it can be used to advantage, eliminating the complication of a separate pump, with its incidental surface suction basin for this service.

In the boosters generally used in these installations the discharge from the well is brought to a complete stop by striking an umbrella separator in the booster, throwing the water to the bottom of the booster and allowing the air to escape from the top. Owing to the complete emulsion of the air and water, a considerable proportion of the air is carried over in the discharge from the booster, and, while this is of benefit where filtration is to be used as above described, it becomes detrimental where this class of booster is discharged into long horizontal lines, on account of the air pocketing in the high points, and also where the discharge is to be carried directly to pumps or condensers. In order to overcome the difficulties above mentioned, and to ensure perfect separation of the air and water, a separator has been designed which consists of a simple shell or cylinder with top and bottom. The combined air and water is discharged into the top and at one side, at a tangent to the periphery, under high velocity from the well, causing it to swirl and effecting a perfect separation of the air and water, the water leaving the separator from an outlet at the bottom, tangent to the periphery, and the air passing off at the top. The downward centrifugal action leaves the air quite dry and frees the water entirely from air bubbles. In this centrifugal arrangement the water is not brought to a dead stop and reversed, with consequent loss of all momentum, as in some older types of boosters, but its direction is gradually changed, so that it is carried on to the outlet of the separator without loss of momentum, and with proportionately greater efficiency.

The Ingersoll-Rand Company has opened an office in Dallas, Texas, located in the Sam Houston Life Building, No. 1521 Commerce Street, with Mr. R. H. Brown, Jr., as manager. Territory to be handled by this office will be that part of Texas previously handled from St. Louis and the entire State of Oklahoma with the exception of Ottawa County, which remains in St. Louis territory. Effective on October 1, Mr. L. J. Davis was made manager of the St. Louis office, which will retain all of its old territory not assigned to the Dallas office. Mr. D. M. Armstead, who has been manager of St. Louis office, has been assigned to the London office as sales manager for continental business, acting under the direction of Mr. W. M. Treglown, Jr., general manager.

Railway Trains Driven by Harnessed Water Power



Photos copyright, Underwood & Underwood.

Compressed air played an important part in the building of the dam at Great Falls, Mont., and in the erection of the power house there. Picture No. 1 shows the dam that collects the water that feeds the turbines shown in Picture No. 2. In the power house are the turbines employed to generate electric current for the operation of the 440-mile electric division of the Chicago, Milwaukee & St. Paul Railroad. This power house also provides current for many local industries. Picture No. 3 shows a limited St. Paul train descending a two per cent. grade on the eastern slope of the Rockies. The electric division of the St. Paul is from Harlowton, Montana, to Avery, Idaho, and eventually will be extended all the way to Seattle, Wash.

William Allen Ragan, for years in the aluminum and white metal alloys business of Indiana, Ohio and Michigan, has started the Ragan Metal Sales Co. with offices in Indianapolis, selling all metals except pig iron and steel.

Ventilation of the Simplon Tunnel*

THE original ventilation plant of the Simplon Tunnel, single in the first instance, was projected by the contractors, Brandt, Brandau & Co., for the construction period rather than for the permanent tunnel service. Two ventilating fans, to be coupled in parallel or in series, were placed at each entrance, Brig in the north, Iselle in the south, each capable of giving 25 cu. m. of air per second at a pressure of 250 mm. of water. By the time the second tunnel was being constructed the transference of the power station to Massaboden had deprived the turbines driving the fans of their water, and the new ventilation plant was designed both for the second period of the building operation and for the permanent ventilation of the two tunnels. Although the old plant had admitted of working with compression or with suction from either tunnel end, the practice had been to force air into the tunnel at Brig and to withdraw it at Iselle. That practice necessitated the provision of a screen at either end.

The new project, which was actually taken in hand in October, 1913, provided for the erection of one ventilation plant only, and this plant was laid down at Brig. A selection had been made in favor of Brig because the central power station was there, because the whole organization of the tunnel service was concentrated at that town, and because meteorological observations proved that the barometric pressure is in general higher at the northern entrance than at the southern entrance, so that the maintenance of an air curret from north to south required less power than a current in the opposite direction.

The best solution of the problem would, of course, have been to have the current in each tunnel in the direction of the train motion, i. e., to force air into tunnel No. 1 at Brig while withdrawing it from tunnel No. 11 at Brig. This plan was not adopted because it had been observed that, when the air was taken in at Iselle, all the iron in the tunnel structure rusted badly. The reason is meteorological. The air at the southern entrance is mostly warmer and more moist than at the northern inlet at Brig; air travelling to the north in the tunnel therefore deposits its moisture as it becomes cooled.

In order to reduce the air resistance to the train and the power demand on the ventilation plant it was decided to open the curtain at Brig, when a train starts at Iselle northwards in tunnel II and to shut the ventilation down for the time of the passage. The maximum air supply was fixed at 90 cu. m. per second for each tunnel, that is, at 180 cu. m. per second altogether, which is a large quantity. The velocity of the air current was fixed at 3 m. or 4 m. per second; a higher air velocity would be decidedly unpleasant to the men in the tunnel. Projects submitted were to conform to these main conditions.

As regards the resistance which the air current would have to overcome, Messrs. Sulzer calculated that the resistance in the tunnel would amount to 60 mm. or 70 mm. of water; 4 mm. more were allowed for the resistance in the feeder trunks. A further factor to be considered was the barometric difference between the two tunnel openings. In general the barometer stands higher at Brig than at Iselle, the difference amounting to 115 mm. of water in exceptional cases. Cases where the atmospheric pressure was higher at Iselle than at Brig were also observed; they are rare, however, and this excess never exceeded 70 mm. The fluctuations in the barometric pressure were, in any case, sufficiently great, however, to make speed regulation of the ventilators desirable, and the specifications called therefore for the following normal (and minimum) figures for each of two ventilators: Air feed in cubic metres per second, 180; head in millimetres of water, 130 (70); effective horsepower at the ventilator shaft, 500 (300); revolutions per minute, 325 (240); efficiency, 0.72 (0.65). The average density of the air is 1.15.

Each ventilator is a fan, 3.5 m. external diameter, 1,564 mm. width, with a central suction opening 2,600 mm. in diameter; the six parallel rows of buckets, built up of wrought-iron blades and partitions, take up 1,284 mm. of the width of the wheel; the hub is of cast iron. The two fans have been mounted in the same building, the one above the other; the air conduit from the lower fan is therefore steeper than that of the other, and the two conduits unite at an acute angle at which the main valve is hinged. This valve, 7.85 m. long and 4.5 m. wide, closes either the lower or the upper conduit, being raised or lowered by machinery or by hand with the aid of two wire ropes. When only one fan is working, this valve closes the other channel; when both fans are run in series, the one draws in air through its suction gate and sends it through the second fan; one conduit thus remains again closed. There are further four valves for the accessory air channels. Each fan weighs 12 tons; the electric motor driving it weighs 11 tons, and the regulating devices, transformers, switches, etc., more than double the latter figure. The casing of each

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*Condensed from *Engineering*.

fan is brickwork, except the first helical portion which is made of sheet iron; the two conduits are square in section, the side being 4.5 m.

Each fan is directly coupled with an asynchronous three-phase motor which is fed with railway currents of 3,200 volts at 16⅔ periods. The speed regulation is effected on the Brown-Boveri-Scherbius system; the rotor current of the motor is not absorbed by resistance, but serves to feed a three-phase collector motor which is coupled with an induction generator sending its current back into the mains; this regulating apparatus alone weighs 9.5 tons. The whole building is a ferro-concrete structure. The lower fan rests on a massive block of concrete; the upper fan is mounted on ferro-concrete beams, but the base is separated from the other parts of the building.

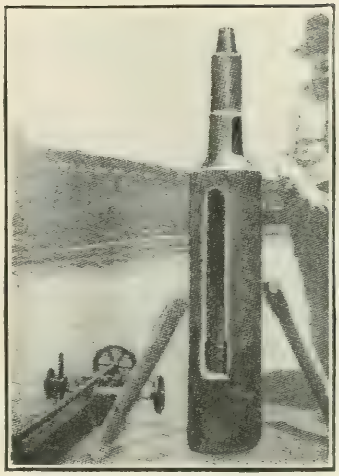
We mentioned that each northern tunnel entrance can be closed by a screen or curtain. For this purpose a portal frame of iron is built into the brickwork, about 2 m. from each tunnel end; the curtain is suspended in the frame by means of chains and can be raised or lowered by means of electric devices or by hand. The lower edge of the curtain, which is made of impregnated sailcloth, is held by a rope of soft copper wire; the track in the plane of the frame is levelled up to the railhead with concrete, and the copper rope rests fairly airtight on the concrete surface when the curtain is lowered. Should accidentally the curtain be down when a train is approaching, the engine would burst through the curtain and the rope of soft copper wire without endangering the train. The curtain is automatically operated with the aid of track contacts.

PRECISION CUTTING BY THE OXY-ACETYLENE BLOW-PIPE

The cutting of slots or openings in solid or tubular iron or steel has been heretofore exclusively a machine shop operation requiring some standard tool, milling machine, slotter, plower or whatnot, and it has not been a job that could be done anywhere or everywhere as might be requested. The operation was not only restricted to the shop and to shop tools but it was also necessarily slow and costly.

Now, however, as is told by Mr. C. C. Philips, in *Natural Gas and Gasoline,* a simple hand-operated carrier, propelled by long screw, and having a lateral arm carrying the oxy-acetylene cutting blow-pipe, takes the place of the expensive machine-tool *in the shop,* and makes possible various forms of cutting-away, or cutting-out, "on-the-job."

Our illustration shows a steel slip-socket weighing 1,600 pounds, with the piece cut-out by the torch-flame, standing to the right. The piece to the left has been cut from the rear of the slip-socket.



SLIP-SOCKET WITH CUTOUTS MADE BY OXY-ACETYLENE.

The pieces cut out by the oxy-acetylene blowpipe were three inches in thickness, and six inches at widest point, four inches wide throughout the balance of the cut, which, all told, was 26 inches long.

In cutting the slots in the slip-socket appearing in our illustration, which work was done at the plant of Acme Fishing Tool Company, of Parkersburg, West Virginia, the socket was laid on its side, parallel to the torch-carrying machine, in the right angle arm of which the cutting-torch was carried.

To describe the method of operation note the following: The torch, as we have said, is carried in the arm of the machine appearing left to right in the picture, and may be moved crosswise of the machine by turning the hand-wheel at the end of the arm. Thus the torch will be moved crosswise of the piece to be cut. By turning either of the hand-wheels at either end of the long screw of the machine, the torch will move parallel to the machine, as the arm carrying the torch has a threaded sleeve, which moves forward or back as desired on the long screw we have mentioned.

The slip-socket appearing in our illustration is used for "fishing" churn drill tools in oil or gas well drillings, where the tools have broken loose from the drilling rope.

It will be easily recognized that if the oxy-acetylene blow-pipe can be used in cutting holes that must be mechanically correct in form and measure, it can certainly be depended upon as the most efficient method of cutting tubing, casing, etc., in the field and at well-drillings, also for cutting-in openings where laterals are to be welded into main lines, or where tubing is to be cut according to shape, in the making of X's, Y's, T's, and crosses for lines "on-the-job," in the field, when laying or relaying lines.

To the inexperienced, the oxy-acetylene cutting-torch looks quite like the oxy-acetylene welding-torch. There is a difference, however, the cutting blow-pipe having an additional jet of oxygen, which does the actual cutting.

In the process of cutting, all that is required is the blow-pipe, the oxygen and the acetylene, while in welding, these two gases and the welding blow-pipe not only are required, but a flux in the welding of cast-iron, while especially prepared "welding-rod" is required, as solder is needed in the soldering of tin-ware. The welding blow-pipe takes the place in welding, of the soldering iron, in soldering. There is a great difference between the two processes, however, for, in soldering, a dissimilar metal is merely *deposited,* whereas, in welding, a similar metal is actually fused or melted into the parent metal.

Just a word in connection with the welding-rod matter should be said to those who are welding, or purpose taking up welding of steel or wrought iron pipe and casings. Never use poor "welding-rod," especially where pressure is to be applied in the pipe, or where that which is conveyed, is of sufficient value to make even slight leakage an expense.

A perfect weld requires not only the services of a capable welder, but also the use of the very best, metallurgically correct "welding-rod." It is the material of the "welding-rod," that builds up and unites the two sections at the point of welding a steel or wrought iron pipe.

Again, speaking of cutting the two slots in the slip-socket, these cuts were so straight and perfect that no finishing after the cutting was necessary, and the two complete cutouts were finished in eight minutes. Formerly it required one machinist eight hours to make the two cuts on a milling. The saving in time and altogether by the use of the oxy-acetylene amounts to twenty-five dollars per socket.

NEW YORK CITY'S METEOROLOGY

A New York City daily recently published some interesting facts regarding average weather conditions in the American metropolis, which would be even more interesting were they compared with similar facts as affecting London. New York, it is noted, lies at the junction of the three great storm paths of the United States, yet it has fewer rainy days than Buffalo, Rochester, Oswego or Albany. It has more dry days than Philadelphia, Pittsburgh, Cincinnati and Cleveland.

In an average year New York has 58 per cent. of the possible amount of sunshine for this latitude. Washington has the same, but Cincinnati, Kansas City and Portland, Ore., have less sunshine.

The average hourly wind velocity at the Central Park Observatory for the last fifty years was seven miles an hour. This is the same as Washington, while Chicago shows sixteen miles and Philadelphia, Indianapolis and San Francisco average ten miles and over.

New York's prevailing winds are from north to west except in June, July and August. Then the winds come from the cooler surface of the ocean and give this Wonder City its deserved reputation as a Summer resort.

New York's temperature, the year round, is more equable than in most American cities. The highest recorded here is 102, and the lowest thirteen below. Cincinnati shows 105, and seven below; Chicago 103, and twenty-three below; St. Louis 107, and twenty-two below; Omaha 106, and thirty-two below; Denver 100, and twenty-nine below.

TO TUNNEL MT. BLANC

A special dispatch from Rome to the *Chicago Tribune,* states that negotiations are being concluded between a representative of a French syndicate and the Italian Government for the construction of a tunnel through Mount Blanc, which will be one of the greatest projects to pass through the Alps. Studies for the project have been going on for about fifteen years. It is now proposed to build an electric railway from Chamonix in Savoy to Amsta in the province of Turin, a length of 50 miles, whereof 10 will be under Mount Blanc. The new railway will join two of the most celebrated valleys with magnificent scenery and perhaps the most renowned among all picturesque cities of the Alps.

Lidgerwood Office in Detroit

The Lidgerwood Mfg. Company of New York, announce the opening of a branch office in the Hammond Building, Detroit, Mich., for the sale of their contractors hoists, derricks and cableways, mine hoists, ships winches and steering gear, and logging machinery. Mr. R. S. Hutchinson, formerly of the Lidgerwood Office in Philadelphia will have charge of the Detroit Office, under the direction of Mr. F. B. Knight of the Lidgerwood Chicago Office, who previously handled this business in Detroit.

I. F. Aguilar Revoredo has opened an office as consulting mining engineer at Casillo 176, Oruro, Bolivia.

Use of Jackhamer Drills for Mine Sampling

*By JOHN H. EGGERS**

SOME years ago, a short article appeared in one of the mining periodicals, which described a method of taking samples with the non-rotating jackhamer, or plugger type of machine drills, with which moil bits were used. In the instance at hand, the work was done with ordinary jackhamer drills and also, though to a less extent, with the stoping drill, using both the regular cross and Carr bits.

Special small non-rotating jackhamer or plugger type of jackhamer drills and moil bits should be of decided advantage in place of hammers and moils in cutting out channel samples, but such special equipment would probably not be available at a property under investigation, whereas the method herein described makes use of the jackhamer and stoping drills, which are more likely to be found as part of the mine equipment.

In the instance at hand, a preliminary inspection of the ore to be sampled, as well as trials by two crews at cutting the samples with hammers and moils, indicated that the rock was extremely hard, and that either a larger crew than desirable or some other method would have to be employed.

At first it was planned to try the jackhamer drill and moil bits, as this method was understood to have been previously used. However, after a consideration of various suggestions (some made by the working crew, for which credit is due), it was decided to use the jackhamer drills and the ordinary crossbits; the plan being to drill two rows of shallow plug holes along the line of the channel to be cut, and to then chip, moil, and break out the undrilled rock remaining between the holes, saving the drillings and the chips as the sample.

As the work progressed, it became apparent that one row of holes drilled sufficiently deep (several inches) would be adequate for the sample, and also that, if the holes were drilled closely enough, the rock between the holes in the row would break out during the drilling. This served to shorten the time required in taking the samples, for one row of holes was found to be sufficient.

The channel cut by drilling one row of holes was rather irregular in outline, being the full width of the drill bit opposite the center of each hole, but only about two-thirds of this width between the holes, so that, instead of being represented by two parallel straight lines, the sides of the channel were represented by two wavy lines that diverged opposite the holes and converged between the holes.

The first cuts were greatly improved upon, when, as the men became accustomed to the work, it was found that by moving the drill and bit from one side to the other, or back and forth along the line of the sample, a channel could be cut out that would be uniform and regular. The final result was a channel, slightly wider than the drill bit, that could be cut to any desired length and depth.

The channel cut as described may be made practically identical, as far as dimensions go, with the usual channel cut in sampling; the only difference being that the greater dimension of the cross-section of the channel, which is usually the width (of from three to six inches), becomes, instead, the depth of the channel, and is dependent on the depth to which the drill is driven into the rock. This may be considered, ordinarily, as an advantage than otherwise, for, owing to the decreased area of the usual irregular surface of the face to be sampled, it allows an approach to a more ideal section or channel. In fact, the face or surface of the rock or ore to be sampled may be cleaned and evened off by drilling a shallow preliminary channel along the line of the sample. The drillings from this preliminary cut would be discarded, and the sample would be taken by deepening the preliminary channel and saving the drillings therefrom as the sample, as described in the details which follow.

There seems to be no reason why the use of machine drills should not be possible in the sampling of many types and structures of rocks and ores, where the employment of the apparatus is justified from an economic point of view, as the practice is dependent largely on the accessibility of the air line, hose and machine drills, and the comparative time required to make the necessary connections.

Though the samples taken in the work described were comparatively small, they were sufficiently large for the purpose at hand, and it is apparent that much larger samples can be cut, with equal and possibly greater advantage, when desired. The use of the machine drills in this particular examination resulted in the securing of a greater number of necessary samples, at less cost per sample, and with a greater degree of accuracy, than would have been possible had hammers and moils been used.

**Abstract from Eng. & Min. Journal, Aug. 30.*

An additional advantage is to be found in that, as the work of the crew becomes largely mechanical, the matter of the personal equation and its possible effects on the sample is largely eliminated. It was also found that practically all of the chips and drillings cut from the channel were saved in the sampling, whereas it is not uncommon, when using hammers and moils, and catching the chips in a candle box, to lose at least a small percentage.

Possibly the greatest advantage is that the method permits the use of power drills instead of hard manual labor. It is significant that though machinery has been adopted for use over a wide range of operations about the mines, most of the work of sampling is still done by manual labor, and there is little reason why the advantages in the use of machinery should not, at least to a considerable degree, be also applicable to this work.

The same procedure applies to the use of the stoping drills in taking overhead samples across the roofs of levels or other workings. However, the action of the stoping drill does not allow of moving the drill backward and forward along the channel, as when using a jackhamer in taking a face sample. For this reason it is necessary to plug holes along the line of the sample; but it is also readily possible to cut out the intervening or undrilled rock remaining between the holes, as well as to cut out all corners, so that, when completed, the channel may be considered as fairly regular and uniform. Greater speed is obtained in using the stoping machine in cutting overhead samples than in using the jackhamer on a face sample, but more care is required to prevent the inclusion of pieces of extraneous ore or rock that might fall from the roof.

The accumulated muck or dust sticking on the walls and roofs of the workings to be sampled was first cleaned off with water under pressure, and also with a broom, and all loose pieces of rock or ore were knocked off.

The portion of the face to be sampled may be further cleaned by drilling a preliminary channel, say about half an inch deep. In the work described the preliminary channel was not cut, owing to the hardness of the rock and the limited time available.

Two pieces of canvas, each about six by eight feet, were then laid down on the floor of the level, in such a manner that one piece overlapped the other several inches. Two pieces were used instead of one large piece of canvas, because they are more easily handled. The area of the canvas should be sufficient so that all of the drillings, say from a 5-ft. sample, can be caught on it, thus avoiding any loss of time that would otherwise result if the canvas had to be moved before the completion of the cutting of the sample.

Though it is possible for one man to operate the jackhamer without a support, it is advisable, particulary in hard rock or ore, to use two men and to furnish a support for the drill, as it is not as tiring, and a greater amount of work and a higher degree of accuracy will result. Two supports were used at different times. One was a short piece of ladder and the other a cross-stand. The stand was made of two pieces of 2-in. pipe about 4 ft. long and two pieces of 2-in. pipe about 6 in. long, screwed into a 2-in. cross, forming an X, in which the two longer pieces were the legs of the stand and the two shorter pieces on top formed the saddle or crotch, in which the jackhamer was placed in an approximately horizontal position, and at right angles to the plane of the stand. Elbows should be screwed on to the lower ends of the legs, as otherwise the sharp edges of the pipe will cut through the canvas.

The cross-stand support, with the longer lengths of pipe down, was placed on the canvas parallel to the wall, and the jackhamer was then placed in the upper crotch between the short pieces of pipe, at such a distance from the wall that the drill-bit would rest at the rock or face.

The driller operated and directed the jackhamer with the assistance of the helper, who at times was required to hold the drill bit at the working face when starting a cut. In addition, the helper had at all times to hold a sack saddled over the drill and against the face, covering the channel sufficiently above and below, so as to prevent the chips and drillings from being lost through flying or scattering off the floor canvas. The sack of cloth was about 12 by 16 in. in size. On one of the longer edges a light stick was nailed, and from the other long edge of the sack a cut or slit was made at right angles for about 8 in. and toward the edge on which the stick was nailed, so that when held horizontally and lowered over the drill, the sack would saddle the drill and permit it to be operated through the slit, the sack covering the face of the rock or ore being sampled. It serves the purpose of a buffer, against which the chips and drillings strike, and then fall to the floor canvas.

The holes in the ends of the drill bits may be plugged with wood, so as to decrease the amount of dust, and possible loss therefrom. The cross bit has the advantage over the Carr bit, at least when starting a cut, but both kinds were used, as some of the crew preferred the Carr bit, whereas others preferred the cross bit.

Boiling and Condensing of Ammonia and of Water

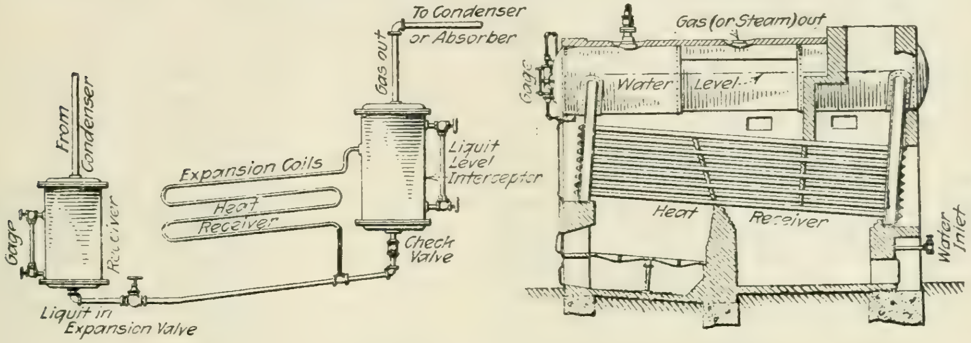


FIG. 1—COMPARISON OF STEAM BOILER AND REFRIGERATING SYSTEM.

THE following interesting and suggestive article by Mr. John E. Starr, Consulting Engineer, Starr Engineering Company, New York City, we reproduce, somewhat abridged, from the July 22 issue of *Power*. The phenomenon here so lucidly explained should be of interest to all students of air compression problems.

The average engineer is familiar with the operation of the solid, liquid and gaseous states of water. That is to say, he quickly grasps the behavior of that substance in its solid, liquid and gaseous states, ice water and steam; and many are acquainted with its state as superheated steam.

It seems well, then, in handling more volatile liquids, as ammonia (NH_3), CO_2 and SO_2, to regard them as we do steam except that they have lower boiling points, and to cling to this analogy. Let us get it into our heads that refrigeration is the reverse of steam heating and keep to this idea, and at once many of the apparent difficulties disappear.

Keep in view that in steam heating we take a liquid (water) and by adding heat to it we produce a gas (steam) which we convey to a cool place, and by condensing it (as in radiators) we give out heat or warm that place; or by condensing it and so reducing its volume to water volume, or allowing it to escape to a lower pressure, we produce power, and in so condensing it we bring it back to water and repeat the process.

In refrigeration we take a liquid (say anhydrous ammonia, or NH_3) introduce it into a warm place (warmer than the boiling point of the NH_3) and *take up heat*, changing the liquid to a gas. By adding heat to this gas in the shape of power, we put it into a condition where heat can be taken out of it by the condensing water and so reduce the gas to liquid, and repeat the process.

In a sense, therefore, the expansion coils may be likened to a steam radiator *reversed*. In a broader sense, where large quantities are handled, the expansion piping may be likened to a steam boiler, and the analogy is a little closer if likened to a water-tube boiler.

If you took a glass two-thirds full of water surrounded by atmosphere and applied heat to bring its temperature to 212 deg., or over, you would expect it to boil and finally "boil away" into a gas (steam). You would expect that about all the heat would go into the water and that you could not add much heat to the *steam*. That is to say, if the upper part of the glass was the same temperature as the lower part—212 deg. F.—then the upper part would be at the same temperature as the lower part.

Now, take the same glass and pour it slowly two-thirds full of anhydrous ammonia. Surround it with a temperature of 28.6 deg. F. below zero. It will boil from a liquid to a gas just the same as water did, and the whole glass will be at —28.6 deg. F. But suppose you surround the glass with a temperature of say 70 above zero. The lower part of the glass, or up to and a little above the liquid level, will still be —28.6 deg. below zero and will accumulate frost on the outside, because it freezes the moisture in the air; but from a little above the liquid level there is no frost, and the glass, while at a little below temperature of the surrounding air (70 deg.) is not frosted. Why? Because although the gas left the surface of the liquid at —28.6 deg., it became rapidly warmed by the surrounding air at 70 deg. and soon above the liquid level the gas received enough heat through the glass from the air to warm it from —28.6 deg. to above 32 deg. or freezing, and no frost appeared near the top of the glass.

A little heat warms up a lot of gas from —28.6 to 32 deg. while the same amount of heat will boil off some liquid ammonia *at* —28.6 deg. Therefore, wherever the heat goes into the *liquid,* the temperature is —28.6 deg. at atmospheric pressure; and where the heat goes into the *gas*, the temperature is above —28.6 deg., or somewhere between —28.6 and the temperature of the surrounding air, +70 deg. in this case. A short distance above the liquid it rises to above 32 deg. and no frost appears.

Fig. 2 shows about what you would see if you put liquid ammonia into a glass exposed to the atmosphere at 70 deg. F. The ammonia when first dropped into the glass will show below —28.6 deg. because some of it has been "absorbed" or mixed with air and cooled the balance below its boiling point. It will then rise to —28.6 deg. if it is pure, and remain at that point as long as a drop remains. Frost will appear wherever the liquid touches. Shortly above the liquid level the gas would show progressively warmer, and just above the level it would show above 32 deg. and the moisture in the air would not freeze on the outside of the glass.

It is now fairly plain why you would not apply fire *above* instead of below the water line of your boiler. No steam would be made. If you did apply some heat below the water line and some above, all that the heat applied *above* would do would be to superheat the stream and you could get only a small amount of heat through a square foot of steam space surface, while you could get a large amount through a square foot of water-wetted surface, for in the latter case you would be changing a liquid to a gas (great increase in volume) while in the former you would only slightly increase the volume at the same pressure. If you filled the glass with ammonia gas instead of liquid, it is plain that you would not get much refrigeration. So we come to the point.

Look after the receiver and be sure you are feeding only liquid, and no gas to the expansion coils.

You can be sure of this only by looking at the gage-glass on the receiver and being sure that the liquid is always in sight and the expansion valve always flooded; also see that little or no heat is added to the pipe between the receiver and the expansion valve. Do not go by "sound" at the expansion valve. The writer can testify that after listening to expansion valves off and on for 30 years he cannot tell by the "sound" whether nothing but liquid is going through or whether 10 or 15 per cent. of gas is mixed with it.

An instance is recalled in Texas where an operating engineer had for 12 years allowed 10 to 30 per cent. of gas to go through with the liquid because his gage-glass was shut off and he was operating the valve by "sound." The loss in coal represented $43,800 in the period.

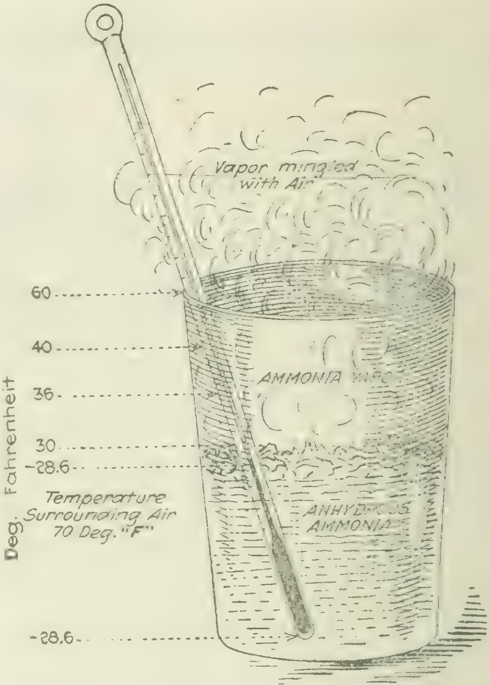


FIG. 2—BOILING LIQUID AMMONIA.

The similarity of a well-designed evaporating ammonia system to a water-tube boiler is illustrated in Fig. 1.

In case of ammonia the heat is received into the evaporating coils, which are full of boiling liquid. The "interceptor" catches any liquid that may "slop over" or be temporarily projected forward mechanically and keeps coils full all the time.

Any irregularity in feed is corrected by the "interceptor," and the liquid is returned to the expansion coils. If liquid is always in sight in the receiver and at about the same height (slightly above the level of the top expansion coil), the system is doing all it can.

So if water is supplied steadily at the feed pipe and kept at the same level in the gage-glass of the drum the steam boiler is doing all it can if in both cases the pipes are clean.

The "disengaging" surface (where gas leaves liquid) in both cases must be ample or the liquid will "foam" or be carried forward to either the compressor or absorber in the case of ammonia or to the engine or heater in the case of steam, where it will do no work and may do harm.

The check valve prevents the gas blowing both ways and insures a coil full of liquid. Some prefer to feed into the top of the interceptor and so allow the gas formed to cool the liquid from condenser temperature to evaporator temperature and pass directly to the compressor. This gas, usually 15 per cent. to 18 per cent. by weight, does not mix with gas formed in the coils. The coils are therefore a little more effective per square foot, as the liquid contains less gas and more liquid-wetted surface per square foot of pipe surface.

It is obvious that we would not want to apply heat only at the interceptor, so we insulate it. Neither would we want to apply a fire *only* above the water-line of the steam boiler.

Now, the importance of watching the gage-glass of the receiver is plain, for although the liquid level in the interceptor may be constant, in a pipe system the liquid may be "shoved ahead" by gas and the first part of the system may contain a large proportion of gas and be less effective.

REORGANIZATION OF THE BUREAU OF MINES

Dr. F. G. Cottrell, chief metallurgist of the Bureau of Mines, who became a national figure through the invention of the Cottrell process for utilizing smelter fume by extraction of arsenic and various other commercial chemicals from the escaping noxious gases, has been named Assistant Director in charge of all investigative and scientific work. F. J. Bailey, for years Chief Clerk of the Bureau, becomes assistant to Director Manning in charge of executive work. J. E. Spurr, who at the outbreak of war became Director of War Minerals Investigations, and after passage of the War Minerals Relief Bill was appointed chief of investigative work in connection with relief claims, has resigned to become editor of the *Engineering & Mining Journal* of New York. No successor to Mr. Spurr has been appointed. H. E. Meyer, Chief Clerk of the War Minerals Relief Commission, has been appointed Chief Clerk of the Bureau of Mines, and C. P. Robertson succeeds Mr. Meyer.

EIGHT SHIPS FOR U. S. STEEL TO BE BUILT AT CHICKASHAW

The United States Steel Corporation, it is announced, is to build eight 10,000-ton steel steamships at the Chickashaw, Ala., yards of the Tennessee Coal, Iron & Railroad Co., one of its subsidiary companies. Steel for the ships will be fabricated at the Fairfield Works of the Tennessee company and routed directly over to the ways of the Chickashaw shipyards. The shipbuilding plant consists of six berths, with a gantry crane for each to swing materials from barges in adjoining wet basins alongside or aboard the hulls.

Material requiring local fabrication is to be delivered to the plate shop's receiving yard at Chickashaw. The plate fabricating shop has two main aisles, each 400 feet long and 80 feet wide served by overhead travelling cranes, and containing angle and plate heating furnaces, punches, plate, planers, shears and bending slabs. The template shop is nearby, a building 61 ft. 6 in. by 300 ft. Also nearby is the brick and steel power house, which in the main is 70x250 ft., with a lean-to on either side for boilers and electrical equipment.

In the power house are installed two 4,000-kw. 60-cycle turbo-generators and condensing apparatus, and three 8,500 cubic feet Ingersoll-Rand air compressors and the machinery auxiliaries required for their operation. To furnish steam power for the operation of the turbo-generators and air compressors there are four 750 h. p. Badenhausen water-tube boilers.

The shipways are designed for side launching of steel cargo vessels, the permanent staging being of steel construction. At the present time there are four 9,600-ton craft on the ways. Construction of six other ships is soon to be begun.

OXY-ACETYLENE TORCH RESCUES A BOY

One of the popular amusement devices at Rockaway Beach, N. Y., is known as the "Witching Waves," the witching of the waves being operated by machinery. A boy, in some way unexplained, crawled under the waves and was caught by what is known as the left arm rocker. This carried his body up against the bottom of the sheet steel wave, clogging the machinery which stopped and held him.

When his cries were heard the fireman were called. The captain tried to pry him loose and then started to chop the machinery to pieces without accomplishing much. An acetylene cutting torch was brought, the steel was cut apart and the boy immediately released, seriously but not fatally injured, although it was thought that he would have died without the help of the oxy-acetylene.

A recent British invention has been made whereby the piston of an internal-combustion engine may be cooled by means of a draft of air circulating through a space in the piston. The draft is provided by means of fan blades on the engine flywheel. On either side of the hollow piston are ports which register with corresponding ports in the cylinder walls at the end of the stroke. A draft of air is thus forced through the hollow space in the piston while all the ports are in line.

F. G. Cottrell, the assistant director of the Bureau of Mines, has returned from an extended stay in Europe, where he made an investigation into the general mineral situation existing there.

America's Future Shipbuilding Market

An Interview with R. H. M. Robinson, formerly Head of the Design and Construction Division of the United States Navy, Authority on Superdreadnoughts, Destroyers and Submarines, now President of the Merchant Shipbuilding Corporation, Independent Steamship Corporation, the Deselektro Co., etc.

NOTE: *In the course of the war the American companies engaged in the supplying of air compressing machinery, riveting hammers and other pneumatic equipment, did a large business with the great shipbuilding plants. A large percentage of the air equipment installed in the yards is still in active use, and in future there is a likelihood that both old and new equipment will continue to be essential requirements in keeping pace with shipbuilding needs.. This much is to be gathered from Mr. Robinson's expressions of opinion on the general situation.*—THE EDITORS.

By FRANCIS JUDSON TIETSORT

TO GET an hour of the time of R. H. M. Robinson, who is among the busiest men of the world's metropolis, one's subject for discussion must arouse his compelling interest. The subject of which he is peculiarly and particularly master, that of the construction of ships, induced him recently to express for publication in these columns his ideas on the topic of the position in which America finds itself with reference to the shipbuilding market.

Mr. Robinson discovered very early in life his predilection and bent for things maritime and naval and decided to make the sea and its affairs his profession. Born in Ohio forty-four years ago, he was graduated from the United States Naval Academy at Annapolis in 1896, completing a postgraduate course two years later at the University of Glasgow. Up until 1902 he was an assistant instructor in the Navy, stationed at the famous Philadelphia yard of Cramps. He was assigned to the New York Navy Yard at Brooklyn in 1902, where he had the distinction of supervising the construction of the battleship *Connecticut.*

Three years afterward, in 1905, his career as a naval expert actually began. It was then that this young man was sent to Washington to become the Assistant to the Chief Constructor of the Navy, in which post for a period of eight years he had charge of the Design and Construction Division in building America's ships of war. In this highly important position he designed our modern battleships, superdreadnoughts, cruisers and destroyers, adding many of their present salient features. His designing and carrying out of the revolutionary idea of the "basket mast" for battleships, made him famous in naval construction circles throughout the world.

Lieutenant Commander Robinson resigned from the service in February, 1915, to become the managing director of the Lake Torpedo Boat Company, in which position he remained until 1917, when he was selected to guide the interests of several great private shipbuilding interests. He is today President of the Merchant Shipbuilding Corporation, President of the Independent Steamship Corporation, and President of the Deselektro Company, the latter a selling and negotiation branch for several large American industries.

He is a member of the University and Engineers clubs, New York City; the Rockaway Hunt; Markham Club, Philadelphia; Army and Navy Club, Washington, and many other clubs and societies. He is too busy a man to go in for sports much, but he is very fond of swimming, a rather unusual attribute of a naval man, and indulges himself in this refreshing exercise whenever opportunity offers.

But Mr. Robinson's time, energies and consuming interest are taken up with shipbuilding problems, and when the subject of the state of the market, present and future, was broached, he declared with conviction:

"I believe there is a deficiency of tonnage."

He explained first of all that he had investigated the curve of tonnage afloat and had taken account of the normal rate of increase. He had also considered the curve of increased production and he had found that it was unlikely these curves would cross before 1927. He was not positive that either the normal increase curve or the production curve would in future proceed on the same angle they had shown prior to 1914. This, he felt, depended on world conditions as affecting production and consumption, such as labor, sporadic Bolshevik outbursts, the vagaries of exchange, and unsettled trade circumstances.

"As to the future of shipbuilding in the United States," he observed, "I pretend to be no seer, but I do hold that it will be affected by world

Photo by Compressed Air Magazine Illustration Service.
R. H. M. ROBINSON AT HIS DESK IN NEW YORK

conditions—by conditions without the United States. Factors that affect us in a domestic sense are the costs of building as compared with the costs of building in the rest of the world. Naturally our builders will have the inside track in building for American account, but when we compete with the world in building tramps we must be able to do it in terms of materials and labor.

"I view it as possible that we shall be able in the United States to build partly for foreign account for the next few years while the foreign yards are still booked up with their own needs. We may be able to get some Scandinavian and other 'neutral' business. Meantime, however, the exchange market greatly affects the situation, and while the needs of Europeans are great, their financial situation seems desperate.

"The greatest demands of America during the war have been for standard cargo-carrying ships of from 5,000 to 9,000 tons' capacity and making from ten to eleven knots. I do not believe that there will be a continued demand for this class of ships here if the Emergency Fleet Corporation adopts a proper policy of sales. If they will let private American owners buy at properly adjusted prices then this country will have more than enough of this class of ships for its present requirements.

"We are deficient in our supply of passenger ships, and have practically none except the seized German tonnage. We also have an insufficient supply of tankers for the present oil needs of the country to say nothing of taking care of the vastly increased oil requirements of the future.

"The United States also is in great need of several types of special ships, such as ore ships, colliers and lumber carriers. The Bethlehem Steel and the United States Steel Corporation are now building ships for their own needs and other steel companies are in need of ships.

"For several years it seems to me there will be activity in the shipyards in supplying the demand for these specialty ships. Then we shall also require what are designated as 'intermediate' ships, those carrying both freight and passengers, besides strictly passenger ships making fourteen knots and up. On the subject of passenger vessels I believe it should be said, that in their construction, designs must be followed that suit them for particular routes. A ship that will answer very well in one service will not answer at all in another, for there are many elements that must be considered, such as length of haul, availability and price of fuel, and classification of traffic. These points, while obvious to the shipbuilder and steamship line manager, are not always so apparent to the less technical promoter. First there must be a decision as to where the passengers are to be carried and as to what route is to be covered; then the ships must be designed for this special service, with time elements taken into consideration."

Mr. Robinson observed that he had left out of calculation, in enumerating the possibilities for building, the coastwise service, which was sure to be developed further to a considerable extent. He had also passed over the matter of navy building, which he was sure would continue, no matter what views might be read here and there in print. He is a believer in the theory that the United States will maintain its safety and prestige with a powerful and an efficient navy as long as there are navies.

The preceding were Mr. Robinson's ideas on the possibilities of the future market for shipbuilders. As to the present state of shipbuilding industry he declared:

"My own belief is that the shipbuilding business in this country is over-expanded. Yards now in the field comprehend several classes of concerns: first, those that are old line established corporations that have been strengthened with accessions of capital; next, the strong new concerns which are expecting to stay in the business; then, the new companies that have not proved to be strong enough and that will be obliged to get out of the game, and finally, those that never expected to stay in the business, but which went in to get some of the cream and are now quitting the field.

"The shipbuilding business was of course enormously expanded in this country because of the necessities of war and the resultant activities of the Emergency Fleet Corporation. The outcome of it all will be, in my opinion, that the old established yards will be strengthened and stiffened in their position and that a few of the strong newcomers will stick in the field.

"The so-called 'agency yards' such as Hog Island, with its fifty ways, are strong enough, but it does not seem reasonable to believe that the Fleet Corporation can keep the entire fifty ways running. I do not believe that this will prove possible. To sum up it seems reasonable to assume that productivity in American hulls will be considerably reduced and that general capacity of yards will soon be lowered. Then, if we can produce on a fairly economical basis in competition with foreign yards and permit ourselves a decent profit, it will be a matter of the survival of the fittest among those American shipbuilding companies that elect to remain in competition with each other."

THE AIRPLANE AS A PACKHORSE

The feasibility of transporting machinery and supplies by airplane to the numerous gold and silver mines in the States of Sinaloa, Mexico, is to be investigated by the British government, according to an article in a recent issue of *Commerce Reports*. According to the story, it appears that a British company is prepared to organize and operate an air service between the mines and railway stations for the transportation of machinery and supplies to the mines, which, due to their mountainous location and the absence of roads, at present are practically isolated. At present it is practically impossible to transport heavy machinery to these mines and the only machinery which can be transported must be carried on the backs of burros, whose maximum limit of carrying is about 300 pounds each. It is understood that it would be the purpose of the proposed company, to transport machinery weighing several tons.

It is often an advantage about a plant to have concrete harden quickly. The Bureau of Standards has developed a method whereby the rate at which concrete increases in strength with age is accelerated by the addition of small quantities of calcium chloride to the mixing water. Tests show that the best results are obtained when from 4 to 6 per cent. of this material—by weight—is added. While no deleterious effects on the durability of plain concrete thus treated have been indicated, on the other hand we are warned against the unrestricted use of this salt in reinforced concrete. Corrosion of ordinary reinforcing takes place in concrete treated with calcium chloride, where this concrete is exposed to weather or water.

Correlating American Speed and French Precision

By LESLIE NEWTON HILDEBRAND

"WHAT can I learn in this country?" was often the contemptuously asked question of the American soldier who read on a bulletin board in a Red Cross recreation hut an announcement of an educational tour to visit some of the various industries of France. Visits to industrial centers and manufacturing plants were fostered by the American Red Cross after the signing of the armistice with the joint purpose of giving education and recreation to the American soldier.

First attempts to give the soldier an insight into French methods of manufacturing were received with some contempt by the average American, aspecially one whose knowledge of France was limited to the war-torn regions over which he had fought. But eager for anything in the nature of a change, he took the trip and returned with a new idea of the industrial development of the country in which he had spent many months as a soldier.

Although France is essentially a farming country, manufacturing and industrial activity forms a large part of the business of France. In the wine growing country of southern France, farming and manufacturing goes hand in hand and each big estate has its vineyard and its factory.

Here the American soldier found machinery made in the United States furnishing the power to press the juice from the grapes and later to bottle them ready for storage or shipment. What the American could not understand was the up-to-date machinery making the wine, and the slow, lumbering oxen doing the plowing. This, the overseer would explain, was due to the fact that the peasants insisted on employing the methods used by their great-grandfathers and a shift to horses, much less to tractors, would cause all of the workmen to leave and go to some nearby farm where they could work in the same manner they always had.

That much of this prejudice against changing old methods will be overcome by the reconstruction which necessarily follows the war, is the opinion of many far-sighted Frenchmen. French business men realize that in re-establishing the devastated regions, the most efficient machinery must be used and there will be no opportunity to go back to many time-honored but less productive methods.

The wine industry was not the only industry the American soldier found in France. Many trips were made to Lyons to visit the big silk factories, known throughout the world. To the casual visitor unfamiliar with manufacturing methods, these trips were interesting because of the fame of the plants. The man with a knowledge of machinery, on the other hand, found in them dozens of ideas of which he made mental note for reference when he returned to the United States.

True, the speed of the American factory was lacking. Two hours for dinner seemed like a waste of time to the practical American. But overlooking this, the soldier saw, at each turn, the French regard for efficiency and minutest detail in each part of the great factories.

Dijon has an establishment that illustrates the French business characteristics. Going under an archway, through heavy bolted doors and along a courtyard, one may find a book printing house. The building looks like a mediaeval mansion kept in good repair, perhaps for the benefit of the tourist. Inside is one of the most up-to-date printing and book binding establishments in France. The proprietor, who speaks both French and English, explained to American visitors that this establishment was founded by his great-grandfather. Later his grandfather conducted the place, then his father, and now he, a middle aged man, is training his son as his successor. The machinery, as it wore out, had been replaced with new material, and none but the latest designs of machines could be found in the shop, yet the building had not been changed since the plant was established more than a century ago.

Here again the American found some things to wonder at, as well as some to praise. Why the front door should be locked and it be necessary to ring a bell to enter the office was unexplainable to the soldier who was used to business methods of the United States. When, also, he was finally shown into the office he wondered if he had made a mistake and drifted into the drawing room of the proprietor's home, so elegantly was it furnished. In this office, too, the proprietor was never too busy to sit down for half an hour or more and talk to an American soldier, to show him the latest piece of fine work, or take him to see any machinery in which he was interested. When the soldier inspected the plant and the products turned out, he was forced to admit that the method of doing business was successful, in France, at least.

Although millions of dollars' worth of machinery was destroyed by the German invasion of northern France, at least one industry is still intact. Pont-a-Mousson, before the war, claimed to produce more lead pipe than any other city in the world. When the German army obtained a foothold on three sides of the city, the inhabitants were ordered to leave. Both armies, hoping to keep the town undamaged for themselves, kept their soldiers out and thus saved the town from shelling. When the armistice was signed, this town remained, surrounded by ruins, undamaged except for a stray shell here and there.

Other factory towns of this region were not so fortunate. Millions of dollars will be necessary to replace the machinery destroyed and carried away by the German army. France, according to many French business men, must obtain this machinery from the United States. France cannot produce it quickly enough, neither can England. The American Red Cross is greatly assisting France in this respect, having authorized an expenditure of 87,000 francs on machinery to harvest the crops in the liberated areas.

The Frenchman cannot understand the American's haste any more than the American can understand the dislike of the French to change existing manners and customs. Perhaps the American doughboy, with his knowledge of French business methods gained on Red Cross educational trips and his knowledge of the French temperament procured by months of living in French environment will help correlate the American business speed and French precision.

MINING ENGINEERS GIVE DINNER TO MR. HOOVER

HERBERT HOOVER, one of the world's great mining engineers, was greeted at a dinner given in his honor at the Waldorf-Astoria, New York City, by nearly 1,300 members of the American Institute of Mining and Metallurgical Engineers and their guests, on the evening of September 16, a few days after his return from his five years' direction of American relief in European countries. Mr. Hoover himself made a great speech and was cheered to the echo. Few men have ever heard such eulogies heaped upon themselves publicly, or heard such salvos of pent-up enthusiasm as were let loose on that occasion in the stately Grand Ball-room of that famous hostelry.

The guests voiced their admiration, respect and esteem for Mr. Hoover not only as an eminent engineer and man; as a food and general relief administrator he was hailed as having shown himself a consummate general and organizer in action. Mr. Hoover was visibly touched by the demonstration and prefaced his formal speech by the helpless inquiry, "Gentlemen, what can I say?" His modest bearing and absolute sincerity of manner had a strong appeal for those gathered to do him honor and bid him welcome home to what he had publicly declared on his arrival from Europe would be "private life."

The toastmaster of the evening, selected to pay the Institute's tribute to Mr. Hoover, was Mr. W. L. Saunders, its Past President, who is chairman of the Naval Consulting Board, and the editor-in-chief of *Compressed Air Magazine*. Mr. Saunders paid the deserved tribute in warmest terms and frequently brought the diners cheering to their feet.

When he said: "The engineer is by education and experience the true captain of industry, fitted to handle the ship of state," there was vociferous approval, the audience rising and cheering because of the suggestion that Hoover might make a presidential candidate.

Mr. Saunders extended a "welcome due an eminent citizen, a successful engineer, a genius of constructive administration, a practical economist and a statesman of world-wide vision." He told how Mr. Hoover got other men to do things and said that "his faith in the moral support of the people was sublime, yet practical."

The toastmaster declared:

"His work was not built upon precedent; there was no experience, no guide. It was in fact a creation. In the words of the Prime Minister of England, his work in Belgium was 'nothing less than a miracle.' Yet it is a fact that those who have been in close touch with the situation say that his greatest work has been done since the Armistice was signed.

"Truly this is a period of new things, new changes, new times; a period of agitation which brings to the front new men of true worth. You who are mining engineers know what a good thing the flotation process is, how by violent stirring up of things the metallic values are separated from the gangue and float off at the top. This process has been in action all over the world during the last five years and it has revealed out of the chaos an engineer of the value of pure gold, one

> Of manners gentle, of affections mild.
> In wit a man, simplicity a child.

"A rugged personality, strong of conviction, modest; thinking never of self; practical, far-seeing, wise, human, brave; with a mind clear in action; a conscience that always functions; one who has saved lives while all others were engaged in destroying them; a rare combination of physical, mental and moral courage; a real American is this Herbert Hoover."

F. J. T.

An Episode of the Recent Strikes in England

THE GRAPHIC
TO CITY TRAINS AND WATERLOO RY

Photo Copyright Keystone View Co.

ENGLAND HAS BEEN IN THE GRIPS OF MUCH MORE SERIOUS STRIKES THAN HAVE BEEN INFLICTED UPON THE PUBLIC IN AMERICA. WHEN THE LONDON POLICE WALKED OUT RECENTLY AND DESERTED THEIR DUTY, THE RAILWAY MEN JOINED THEM. OUR PHOTOGRAPH SHOWS THE IMMENSE CROWDS AROUND A SUBWAY STATION THAT ARE WAITING FOR A MEANS OF CONVEYANCE TO THEIR HOMES.

A feature of the strike as pertaining to London's underground system, and reported by Capt. Thomas C. Watson in a copyrighted dispatch to the Philadelphia *Public Ledger,* was that numerous former officers and soldiers of the British Army were organized into a corps of efficient amateurs to run the trains and perform other incidental duties. Capt. Watson wrote:

"I found Majors clipping tickets, Captains ushering passengers into their right compartments and young Lieutenants sweeping the platforms of trains, being most efficiently driven by exploits of the flying corps.

"No task was too menial or too important. They led their troglodytical existence in the catacombs of London with all the cheerfulness they showed in Verdun. The atmosphere of the army in France was ever present. Tunnelled London reminded one of sectors of the battle fronts. One thought of Verdun, Gibraltar and Helgoland.

"The frontier workers were concentrated at one point and from there all sections of London's battle line were fed. Hammersmith and Earl's Court, two important centres, were organized on the lines of infantry base depots. Here they rest. Canteens, reading and writing rooms were established. A part of the stations had been converted into a sleeping room. Beds were arranged with soldierly precision, with blankets and bedding neatly folded."

Europe Facing A Coal Famine

Urgent Demand Being Made Upon Shipping Board to Forefend Distress. Analysis of Situation Shows European Nations Are Using Own Tonnage to Carry High Priced Cargoes, Leaving to America the Job of Freighting the Less Profitable Coal Cargoes to Their Own Home Ports

WITH the approach of winter the greatest menace to life in Europe draws on apace. The greatest stress and danger lies in the lack of coal. America has a boundless quantity, but incredible as it may seem, America cannot supply the need of Europe. Nor can Great Britain, with its annual production of 287,412,000 tons shrunk to 214,000,000, Germany's decline being even greater. And while Great Britain's pre-war export of coal ran to 76,689,000 tons, her estimated post-war exports are only 23,000,000 or less.

To avert a world shortage America would have to export 81,000,000 tons. The nation's pre-war export of coal was less than 20,000,000 tons. The excess over pre-war exports which must be supplied by this country, if the world shortage is to be made up, is 62,463,000 tons. This shortage cannot be met. To make up the deficiency America would have to export within the next few months more than four times as much as it ever exported in an entire year. There is not enough tonnage available. With the trebling food exports even an extra million tons a month would tax shipping beyond its utmost limit. And even that extra million would be of no avail in relieving the distress that threatens Europe.

No phase of world conditions has more closely occupied the United States Shipping Board than this matter of coal for Europe. Keenly alive to the situation, Mr. J. H. Rosseter, Director of the Division of Operations, had Mr. H. Y. Saint, head of the Export Coal Department of his division, compile the report which we present here. It portrays the abnormal demand that is being made upon the United States to take care of Europe from a coal standpoint, shows that the demand that is being made upon the Shipping Board for tonnage to be placed in the coal trade is many times greater than can be supplied, and what is more significant, shows that European nations are doing little or nothing to relieve the situation by using their own tonnage, moreover, that the nations which are doing the least are the ones that are able to do the most.

The outstanding fact, brought out by this analysis, is that European nations are using their own tonnage in trades best suited to their maritime interests and in competition with Shipping Board vessels, leaving Uncle Sam to carry the less profitable coal cargoes for the relief of suffering peoples.

"It would seem," reported Mr. Saint, "cognizance must be taken by the Shipping Board of this situation and that something should be done to bring European tonnage into this work of distributing coal to European ports. The statistics compiled by this department show that Italy is practically the only European government which is extensively using its own vessels in carrying coal from the United States for Italian relief. In the month of July, 20 Italian vessels sailed from American ports with coal. You will notice that Norwegian, British and Greek ships were plying in the Italian trade, which today is considered a profitable one. At the same time the Shipping Board was having demands made upon it to carry coal to Greece, Switzerland and the Scandinavian countries as well as to South America.

Very heavy demands are being made upon the Shipping Board to carry coal to Denmark. Our tabulation shows that no Danish vessels are carrying coal to Denmark, but a number of Danish ships are carrying coal from American ports to South America, which is a profitable trade when the return cargo situation is taken into account.

It will be noted that Norwegian and Italian vessels are under charter to carry coal to Gibraltar, when the needs in their own countries are great.

Large demands have been made upon American tonnage to carry coal to the Netherlands, and during July, 17 American vessels sailed from American ports to that country. During the same period only three Dutch ships carried coal to their home ports while two Swedish and one Norwegian ship were in the Dutch coal trade.

Insistent requests have been made on the Shipping Board to carry coal to Sweden, and as many as 11 steamships have sailed in one month for that country. Yet Swedish steamships in that trade have not exceeded one a month.

With the increasing demand upon America to supply coal for Europe and to carry it in American bottoms, and with all the demands predicted upon the increasing distress in various European countries, it would seem that immediate steps must be taken to bring about an effort on the part of the various countries to help themselves in this matter of coal distribution.

In view of the fact that the Shipping Board cannot meet the demands that are being made upon it, in view also of the fact that our vessels are now being used to relieve distress in Europe where the distress is greatest and relief most urgent, it seems imperative that the European nations which are facing a coal famine should do something to relieve the situation by placing some of their own tonnage in the American coal trade, even though that trade is less profitable than the ones on which these vessels have been placed to compete with the new fleet of the U. S. Shipping Board.

From the analysis made by Mr. Saint it appears certain that the people of France, Belgium, Holland, Italy, Denmark, Norway, Sweden, Spain and Switzerland will be among the ones that must suffer most and that the shortage will fall with no less weight upon Germany, Austria-Hungary, including Czecho-Slovakia and Jugo-Slovakia. The total coal requirements of the world next winter have been placed by this authority at 179,511,000 tons, of which 97,723,000 tons can be supplied by countries other than the United States.

This would leave 81,788,000 tons to be furnished by this country. Mr. Saint estimates that there will be furnished 19,325,000 tons, leaving a shortage in the world's coal bin of 62,463.000 tons, a tonnage sufficient to supply the New England States for nearly three years. Translated into other terms, it would require 1,249.000 cars of fifty tons capacity each, to meet the shortage, or 25,000 trains of fifty cars each. Twelve thousand, five hundred vessels of 5,000 ton's capacity each would be necessary to carry the cargo across the ocean in one trip. More than 60,000 men would have to dig coal at top speed for a year to produce the tonnage.

HENRY M. ROBINSON RESIGNS FROM SHIPPING BOARD

Mr. Henry M. Robinson, whose resignation as Commissioner of the United States Shipping Board was accepted by President Wilson, closed up his desk on August 13 and left for his home in the west. It was while he was abroad as special representative of the Shipping Board that Mr. Robinson was appointed Commissioner, succeeding Charles R. Page, who had resigned. He returned from the special mission in June and had been on duty with the Board since.

At the outbreak of the war Mr. Robinson went to Washington as a volunteer war worker, and became a member of the Advisory Commission of the Council of National Defense. He was for a time Chairman of the Labor Supply Committee, and later of the Committee on State Councils of National Defense, forming the connecting link between the latter and the National Body.

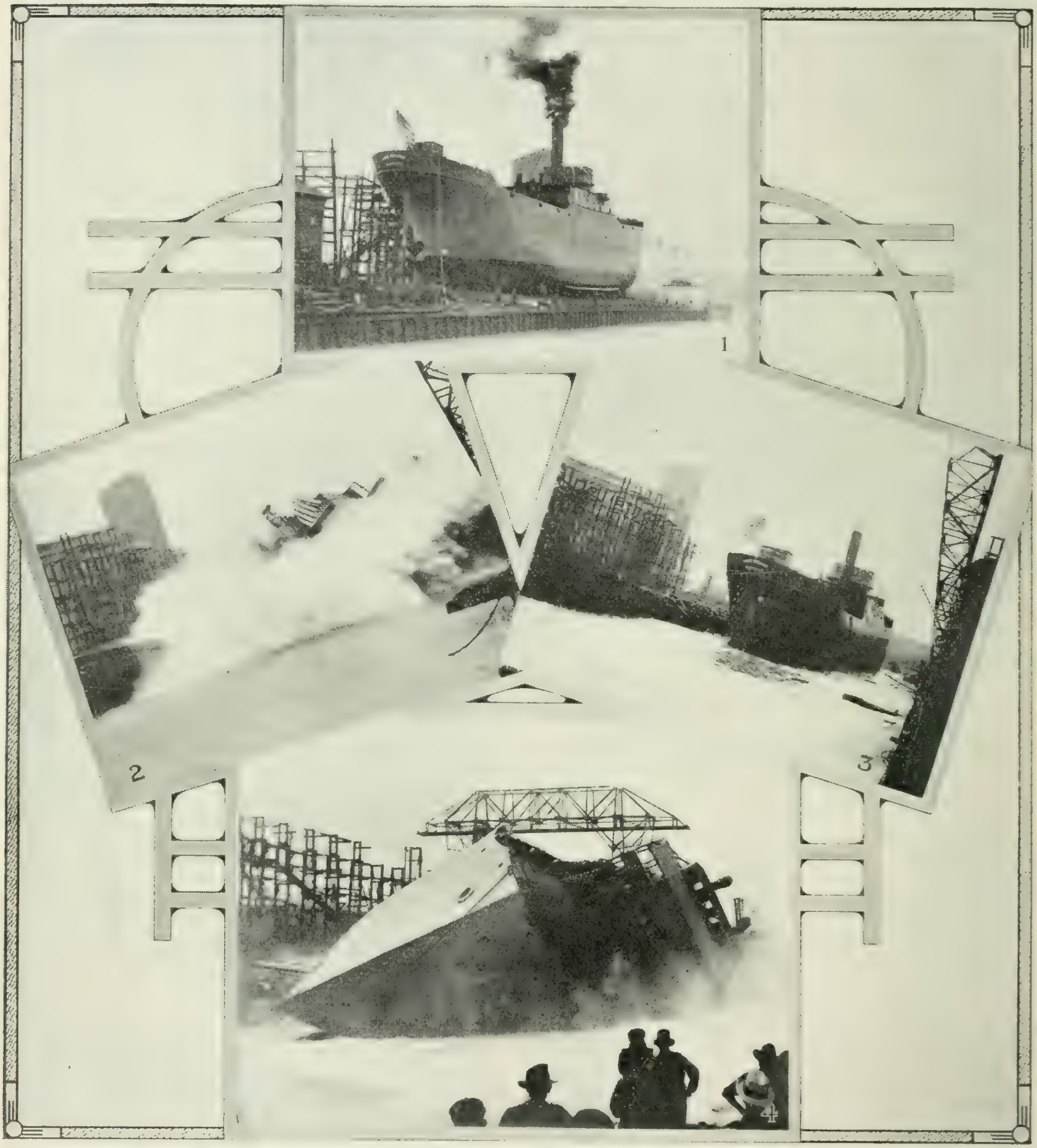
In the early fall of 1918, Mr. E. N. Hurley; then Chairman of the Shipping Board, appointed Mr. Robinson as assistant Chairman, Mr. Robinson's particular responsibilities being connected with the study and formulation of plans for the future policy of the Government with relation to an American merchant marine. Upon the signing of the armistice, Mr. Robinson assembled the Shipping data necessary for the use of the Peace conference.

[illegible] N[illegible] RAISE A SHIP

Some valuable and interesting experiments have recently been carried out on the raising of a ship, the S. S. *Main,* which was sunk by gunfire from a German submarine in Luce Bay, in the south of Scotland, during the war. The salvage operations were carried out by the Ardrossan Salvage Company, Glasgow, who undertook to test some flexible pontoons, designed, patented and manufactured by Vickers Limited, Barrow-in-Furness. The pontoons are made of special canvas and cables, and weigh when completed only 1 ton, yet when inflated with air and submerged in water are capable of lifting 100 tons. On the trials, two of these 100-ton pontoons were used and fixed to the stern-post of the ship and inflated by means of an air compressor on a small tug. The vessel was slowly raised and beached ready for pumping out on the 19th inst. The amount of rough handling which these canvas pontoons withstood was remarkable. One great advantage they possess is that when not in use they can be packed into a very small compass and stored in the hold of a salvage ship and need only be brought out when actually required. The ordinary barges or lighters used for ship lifting are very expensive, both in initial cost and during use. They have to be towed to the scene of operations, and if any bad weather occurs they are in great danger of damage. Very often salvage operations are necessary in order to recover the wrecked salvage gear. From the information gained during these tests, the designers are now confident that pontoons of 200 and 300 tons lifting capacity can be made in the same manner.—*The Engineer,* London.

What is believed to be a world's record for gliding with a dead motor was accomplished at Ithaca, N. Y., in a Thomas-Morse two-seater biplane. This machine flew to the head of Cayuga Lake, a distance of 35 miles, and having attained a height of 17 500 feet, the pilot switched off his motor and glided to Ithaca, at which point he still had 5,000 feet altitude. If his glide had been continued it is estimated that an additional 15 miles could have been covered, making a total of 50 miles without the use of his motor. The longest glide previously recorded was that of Capt. Raynham, according to *Aeronautics,* when he glided from Brooklands to Hendon, in England, a distance of 22 miles.

The Most Remarkable Launching in the History of Shipbuilding



Photos Copyright Keystone View Co.

THE *LAKE FUGARD*, WHICH WAS ONE OF THE LAST EMERGENCY FLEET CORPORATION VESSELS, WAS LAUNCHED AT THE BUFFALO DRY DOCKS WITH ENGINES AND BOILERS INSTALLED AND STEAM ALREADY UP. IT WAS THE FIRST TIME A FINISHED SHIP HAD GONE SUCCESSFULLY DOWN THE WAYS AFTER A DROP OF 23 FEET FROM TOP OF WAY. THE CRAFT TIPPED OVER AT THE EXTRAORDINARY ANGLE OF 70 DEGREES AND AIDED BY THE REBOUNDING WATER IN HER NARROW SLIP ALMOST MIRACULOUSLY RIGHTED HERSELF. A SHIP USUALLY CAPSIZES AT 60 DEGREES.

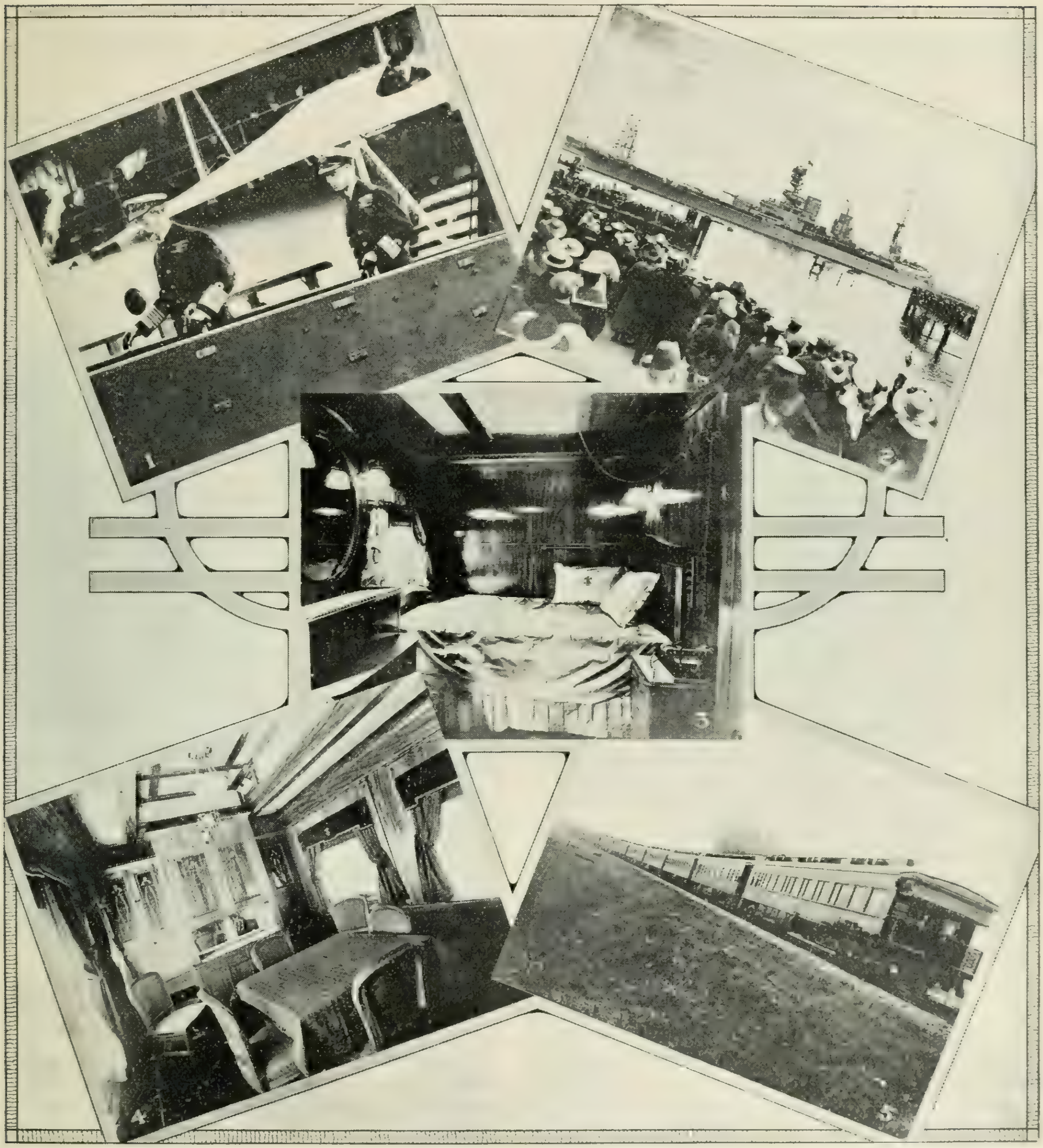
FIG. 1—THE *LAKE FUGARD* JUST BEFORE IT WAS LAUNCHED SIDEWISE.

FIG. 2—THE LAUNCH AND THE DANGEROUS ANGLE OF 70 DEGREES.

FIG. 3—THE STEAMER AFTER BEING LAUNCHED COMPLETE. WITHIN AN HOUR SHE WAS LOADING CARGO.

FIG. 4—VIEW OF THE VESSEL AS IT BEGAN TO RIGHT ITSELF.

The Visit of the Prince of Wales to America



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THE VISIT OF THE AMIABLE AND HANDSOME YOUNG PRINCE OF WALES TO AMERICA, LIKE OTHER PRECEDING VISITS OF MEMBERS OF BRITISH ROYALTY TO AMERICA, HAS BEEN AN HISTORIC EVENT. EVERYWHERE HE HAS BEEN WARMLY WELCOMED, NOT ONLY BECAUSE HE IS THE HEIR TO THE THRONE OF ENGLAND, BUT BECAUSE OF HIS WINNING PERSONALITY.

FIG. 1—THE PRINCE FOLLOWING HIS FATHER, THE KING, ON BOARD THE *RENOWN* BEFORE HE SAILED FOR CANADA.

FIG. 2—H. M. S. *RENOWN* STEAMING OUT OF PORTSMOUTH HARBOR WITH THE PRINCE ON BOARD.

FIG. 3—THE PRINCE OF WALES HAS HAD AS HIS RESIDENCE FOR TWO MONTHS A BRAND NEW AND PALATIAL TRAIN WITH A PICKED CREW OF TRAINMEN. THIS VIEW SHOWS HIS LUXURIOUS SLEEPING QUARTERS ON BOARD, LOCATED IN THE PRIVATE CAR *KILLARNEY*, WHICH WITH THE PRIVATE CAR *CROMARTY* WAS LOANED BY LORD SHAUGHNESSY. BESIDES THE PRINCE'S BEDROOM, THE *KILLARNEY* ALSO CONTAINS A SECRETARY'S BEDROOM, SHOWER BATH, DINING ROOM FOR SIX, KITCHENETTE AND CHEF'S BEDROOM. THERE IS AN OBSERVATION PLATFORM ON WHICH THREE SEARCHLIGHTS ARE MOUNTED FOR NIGHT USE.

FIG. 4—THE PRINCE'S DINING ROOM ON BOARD THE TRAIN.

FIG. 5—THE COMPLETE TRAIN, SHOWING OBSERVATION PLATFORM AND SEARCHLIGHTS.

A Sketch of William Lawrence Saunders

Engineer and Inventor, Author, Traveler, Popular Executive, Public Servant, and above all—a Man

NOTE—*It is not often that the occasion arises for a publication to print such an article as the one subjoined, about its own editor-in-chief. This sketch, prepared at the request of Power Plant Engineering, and originally published in that journal, is reproduced through the courtesy of our contemporary as a tribute to a great engineer, writer and editor, from the fellow members of his editorial staff of Compressed Air Magazine. Mr. Hirschberg has ably summed up the salient points in a career that has led to high place. Mr. Saunders lately had the distinction of presiding at the great dinner given by the American Society of Mining and Metallurgical Engineers at the Waldorf-Astoria, New York, in honor of that great mining engineer and executive, Mr. Herbert Hoover, upon his return from Europe to private life. His speech of eulogy and welcome brought the 1,300 cheering diners repeatedly to their feet.*—THE EDITORS.

By CHARLES AUSTIN HIRSCHBERG

HISTORY repeats itself in individuals as well as in world events. The remarkable persistence, "go-ahead," determination, ability to overcome obstacles, and creative genius of his ancestors, who, as a member of that sturdy band of men forming the historical Jamestown Expedition, braved the dangers of an unknown land and established the earliest Virginia Settlement (1607) is reflected in the remarkable career of William Lawrence Saunders, known not alone in his own country, but by the world at large for the things he has done to benefit mankind.

Possessing the imagination to conceive, the understanding to direct, and the hand to execute, he has, from the time of his graduation, as a member of the famous Centennial Class of the University of Pennsylvania (1876), been actively identified with some of the world's greatest engineering undertakings, either in directing their execution or in the development of the implements and methods for carrying them on.

Early in life he exhibited a leaning toward the science of engineering and mechanics. He first practised as a civil engineer in 1878 in charge of hydrographic work, the intervening time between graduation and this undertaking being devoted to special newspaper work for Philadelphia papers and as correspondent at the Centennial Exhibition for a number of Southern newspapers. He made two balloon ascensions with Samuel A. King, the famous aeronaut, at the exhibition grounds. On one of these ascensions the balloon reached the height of three and a half miles and remained in the air all night, a remarkable feat at that time.

The years 1879-1881 found Mr. Saunders acting in the capacity of engineer for the National Storage Co. at Communipaw, N. J. He made a series of soundings in New York Bay preliminary to the erection of the National Docks on the New Jersey water front. He also had charge of the construction of piers, warehouses, docks and the ship channel, from the main New York Channel to Black Tom Island on the New Jersey Shore.

WILLIAM LAWRENCE SAUNDERS

It was about this time that his inventive ability first displayed itself. While cutting the ship channel a ledge of hard rock overlaid with gravel and hardpan was encountered. This required drilling and blasting under water, a difficult operation at that time with the implements available. To overcome the difficulties presented, Mr. Saunders made a number of personal experiments in a diving suit, which led to the invention and patenting of appliances for subaqueous drilling, which are still in fashion today and generally used.

He also invented and patented a system of pumping liquids by compressed air, used by municipalities and power plants for water supply, and in the oil fields for obtaining the oil from the bowels of the earth. The Radialaxe system of coal mining is another invention of his fertile brain, as well as innovations covering the drilling and quarrying of rock. These inventions, along with others, called out improvements in air compressor design and the development of a long list of pneumatic machinery used in practically every industry.

Most of these contributions to the mechanical arts were made after he became identified with the Ingersoll-Rock Drill Co. (1881) in the capacity of engineer. Thus began a life-long association, now 38 years, which was to lead him through successive stages to the topmost rung of the ladder in the counsels of a large and important business. He was the first president of the Ingersoll-Rand Co., and is today chairman of the Board. He is president of the Ingersoll-Sargent Drill Co. and a director of the A. S. Cameron Steam Pump Works.

While still at college he showed ability as a writer, was editor-in-chief of the "University Magazine," and was elected class poet. This early predilection has remained with him throughout his life, and we find he is the author and coauthor of a number of engineering books, scientific articles and papers on national and international topics. His work has brought him in contact not only with men of renown within his own immediate business sphere, but also with those high in the counsels of the nation. He is an admirer and warm personal friend of President Woodrow Wilson. During the late national emergency—the World War—in his capacity as Chairman of the Naval Consulting Board, of which Thomas A. Edison was President, his counsels served the country well. He stood as close to Secretary Daniels of the United States Navy as perhaps anyone.

As a lecturer and toastmaster he is well known, being noted for his ready wit, a wide knowledge of all subjects, entertaining and enlightening. He adorns whatever subject he either speaks or writes upon by the most splendid eloquence. As a business executive he is pre-eminently successful, having been largely responsible for the upbuilding of the Ingersoll-Rand Co.'s business from its small beginning to its present position.

Pressed for a statement as to what he attributed this success, Mr. Saunders modestly parried the question by laying down the following rules for success in life, which, it is to be noted, define success not merely in a materially commercial sense, but from the broad human standpoint.

"Always bear this in mind: 'Let him that thinketh he standeth take heed lest he fall.' "

"No one can live in the world without the helping hand of his associates; never forget to hold that hand for all time."

"Try to pick out good men and then back them to the limit by putting responsibilities upon them."

"To remove mountains, we should begin on grains of sand."

"If you can't do the best thing, you should be glad to do the next best."

"There are greater things in the world than money."

"Work till it hurts."

Mr. Saunders at the age of 62 is still a young man in vigor of mind and body, the result of right living and right thinking.

He is the imitator of no one. The things he has done and is still doing all bespeak the work of a master mind. A firm believer in the power of publicity for good, when applied in a meritorious cause, he prides himself on the fact that in his earlier association with the company he carried on this important work along with a multitudes of other duties. He always looks upon things from the standpoint of the man; he believes that the man makes the job, not the job the man, or, as he characteristically expresses it, "The value of every job is in the value of the man." This well-founded belief has made him a keen student and judge of men generally, and as a result he has been able to surround himself with men of ability, thereby enhancing his own success.

He is an inspiration to all with whom he comes in contact, and is noted for his just yet kindly decisions. It has been said of him "That when satisfied the cause is just, he will hazard all, wherever it may lead." A firm believer in humankind, he always sees the good in everyone.

Mr. Saunders, previous to the World War, was an extensive traveler, accompanying a number of scientific expeditions, and his contributions to engineering literature are based upon first-hand investigations.

He is so versatile that Dryden's words, "A man so various that he seems to be, not one but all mankind's epitome," fit him well.

Following is a brief sketch of his life and the things he has done. It evidences the confidence displayed in him by all with whom he has come in contact, and forms a true expression of the "value of the man."

He was born November 1, 1856, at Columbus, Ga., the son of William Trebell Saunders, D. D., and Eliza Morton Saunders. He received the degree of Bachelor of Science, University of Pennsylvania, in 1876, and of Doctor of Science, 1911. Mr. Saunders is now a director of the American International Corporation, president and director Muhlenberg Hospital of Plainfield, N. J.; director American Manufacturers Export Association, director Federal Reserve Bank of New York. He is a member of the District Committee on Capital Issues of the Federal Reserve Board, New York Chamber of Commerce, U. S. Chamber of Commerce, New York Foreign Trade Council, National Civic Federation (Chairman of the New York Welfare Committee), National Democratic Club, Executive Committee, League to Enforce Peace, and chairman Nicaragua Permanent Pan-American International High Commission. He was appointed by President Wilson as a member of the New Jersey Harbor Commission, and is associated with the New Jersey Board of Commerce and Navigation. He was nominated by the American Institute of Mining Engineers and appointed by the Secretary of the Navy as a member of the Naval Consulting Board of the United States and served as chairman. He was also a member of the Advisory Board, United States Fuel Administration for New Jersey. Formerly a member of the New Jersey State Democratic Committee, he was also President Wilson's personal representative from New Jersey on the National Campaign Committee in 1916. He was twice elected mayor of N. Plainfield, N. J.

Mr. Saunders is a past president and director, American Institute of Mining and Metallurgical Engineers, and a director, formerly president, Machinery Club; also director, India House. He is also associated with the University of Pennsylvania Club of New York (President and member of the Council), Aero Club, Engineers' Club, University Club, American Society of Civil Engineers, American Society of Mechanical Engineers, Mining and Metallurgical Society of America, American Iron and Steel Institute, United Engineering Society (trustee), American Academy of Political and Social Science, Philadelphia, the Academy of Political Science in the City of New York, and of the American Geographical Society.

He is editor of *Compressed Air Magazine*, author of "Compressed Air Information," "Compressed Air Production," co-author of "The Subways and Tunnels of New York" and "Rock Drilling." Among his numerous other publications are: "Compressed Air, Its Production, Transmission and Use," "A Practical Consideration of Compressed Air," "Quarrying by the Channeling Process," "The History of the Rock Drill," "Rock Drilling Economics," "Tunnel Driving in the Alps," "Right and Strength in Equal Suffrage," "Reveries of a Business Man," "Business and Politics and the Anti-Trust Laws," "Government Regulation of Commerce as Affecting Foreign Trade," and "Compressed Air in the Arts and Industries" for the International Engineering Congress, San Francisco, 1915.

INTERNATIONAL STANDARDS

The American Engineering Standards Committee gave a dinner—its first recorded function—on Sept. 18, at the Engineers' Club, New York, in honor of Mr. Charles LeMaistre, Secretary of the British Engineering Standards Association. The dinner was attended by more than fifty engineers representing practically every organization interested. Mr. LeMaistre gave a highly interesting address, speaking of the high ideals of the British Engineering Standards Association and of the good work already accomplished.

"The B. E. S. A. was formed," he said, "in 1901 at the instance of Sir John Wolfe Barry, the dean of our engineering profession, and it was through his able guidance during some sixteen years of the most important period of its existence that the Association gradually gained the confidence of the people. We are now an organization of some three hundred committees"—just think of it "and twelve hundred members who give their time fully to the work.

"We realize more and more that standardization is, shall I say, 15 per cent. technical and 85 per cent. human. Standardization is an industrial matter and it is the industry that should put up the standards and get the help of the engineers and experts to support them.

"Standardization means efficient production. It can only be effective when overlapping is avoided. Overlapping can only be obviated by the operation of some central organization, which we have provided in Great Britain with wonderful effect. We find now that overlapping of effort is becoming less and less each year, and the B. E. S. A. is becoming more and more recognized as the central authority for drawing up standards for the engineering and allied industries

"If only we could get coördination of standardization on both sides of the water, one central authority on each side, it would not only help our industries enormously, but we could work hand in hand on these technical problems which involve this complicated human factor, and in doing this big work we would surely be no mean influence in promoting the peace of the world."

Following Mr. LeMaitre's address the representatives of the various organizations pledged their support of the contemplated development of the American Committee. Dr. S. W. Stratton, Director of the Bureau of Standards, reiterated the readiness of the Government Departments to coöperate in the development of the Committee's programme.

Notes of Industry

The Morse Dry Dock & Repair Co. of Brooklyn, now has in commission the fifth section of its new 30,000 ton floating dry dock and is equipped to raise vessels of over 24,000 tons and 625 feet long. This month the sixth section will be in place, thus completing the largest dry dock of its kind in the world. Mr. E. P. Morse announces that the plant continues under the same management and has not been sold to the Government as has been rumored. "The property is not for sale; neither do we propose to sell any of our present holdings or equipment. To the contrary we intend to continue our policy of expansion with the object of giving to the port of New York, ship repairing facilities second to none in the world," he states.

William Beardmore & Company, Dalmuir-on-the-Clyde, has received a contract from the Australian Government for two cargo steamers of 22,500 tons each. The vessels will be 530 feet between perpendiculars, 68-foot beam and 43 feet 6 inches molded depth. Three vessels of a similar size are to be built by Vickers, Ltd., Barrow-in-Furness. Report has also been received that six 12,000-ton vessels will be built in Australia for the Government.

The Van Wie Pump Company of Syracuse, N. Y., successors to the Baldwinsville Centrifugal Pump Works, established in 1860, has withdrawn from the field and sold its entire business, drawings, patterns, good will, etc., to the East Iron & Machine Co., Lima, Ohio. The East company will continue to make the Van Wie centrifugal and triplex pumps and will also make repairs and repair parts, it is stated.

Announcement has been made by the Calumet and Hecla, Osceola consolidated Ahmeek Copper Company, Allouez Mining Company, La Salle Company, Lake Milling, Smelting and Refining Company, Superior Copper Company, Isle Royale Consolidated, and the White Pine Copper Company, employing 11,000 men, that every employe has been granted a free life insurance policy, in sums ranging from $1,000 to $1,500, payable to any named beneficiary, dated Oct. 1, 1919, without medical examination and without cost to himself.

One American company alone, during 1918, built, according to *Power*, over 500 synchronous motors, aggregating 300,000 h.p. capacity. Of this number over 200 motors, with an aggregate capacity of 90,000 h.p., were built for air-compressor drive alone. More than 86% of this horse power was for the driving of Ingersoll-Rand Class "PRE" compressors. When it is considered that this represents the output of one company only, and that there are a half-dozen or more large companies building this type of machine, it will at once become apparent what an important factor the synchronous motor is becoming.

Dealers in, as well as original sellers of, iron and steel scrap from explosive plants are warned by the Bureau of Explosives, New York, in a special bulletin, to guard against explosions caused by guncotton, picric acid, or TNT inside of pipes or receptacles. The following are instances of such accidents: Damage to a metal plant in the melting down of lead pipe containing picric acid, explosion in a storage yard because of contact of a lighted match with nitrocellulose, the severing of a hand from an explosion resulting from the crushing of pipe between two hammers, killing of employees cutting up pipe from the oil fields of Oklahoma, in which a detonating cartridge had been left. One explosive company makes a double inspection of all pipe leaving its plants; it is first burned in a woodpile and then inspected, each piece being marked with red paint; after it is loaded on cars another inspection is made, markings with blue paint indicating it.

At last the corn crop has to come to its own. The cob has been relegated to the scrap heap for a great many years as a worthless appendage after it had served its primal purpose. It is true that pipes of peace have been made out of it, but now comes the Department of Agriculture and is ready to utilize it, for it has been found that 35 per cent. of it is transformable into crystalline glucose which has many uses, one of them being the production of alcohol. Another use is adhesive which is used in making fibre boards and paper boxes. This adhesive could be made colorless and would replace the starch, dextrine, flour paste and only 3 per cent. of the cobs would have to be used to replace all this.

The American Ship Building Company, Cleveland, it is understood, has received orders for two large ore carriers and ten vessels of the Welland Canal size, which will be used in the Atlantic service.

The Sun Shipbuilding Company, Chester, Pa., has closed a contract for two tankers. C. E. Hendrixson is the purchasing agent of the company.

The Union Construction Company, Oakland, Cal., has been awarded a contract by the Standard Oil Company of California, to build a 2,800-ton oil tanker equipped with Diesel engines. The contract for the engines is held by the Skandia Pacific Oil Engine Company, Oakland, Cal.

The Stow Manufacturing Co., portable tool manufacturers of Binghampton, N. Y., have issued two new bulletins, Nos. 103 and 104, describing and illustrating their line. These are the first bulletins the company has issued since before the war.

A steam-driven turbo-blower has been sold by the Rateau Battu Smoot Engineering Corporation, New York, to the Famatina Mining Corporation, Argentine Republic. The blower is to deliver 7,000 cu. ft. of air at 14 lb. pressure. The speed of the unit is 22,000 r.p.m. The turbine operates at 150 lb. of steam pressure and a vacuum of 28 in.

Attention is called to the new annual United States Official Postal Guide which contains full postal information including a list of all post offices in the United States. The Guide is of special value to those who use the postal service extensively, particularly in the shipment of parcel post matter. The subscription price is 65 cents with 35 cents additional if the 11 monthly supplements published during the year are desired. Subscription blanks may be obtained at the General Post Office or any carrier station.

A new record for fast runs with a heavy train was made recently by eastbound express train No. 4 of the New York Central, Western Lines, on Sunday, May 14. This train covered the distance from Elkhart, Ind., to Toledo, Ohio, 133.01 miles, in one hour, 54 minutes, or at the rate of 70 miles an hour. The distance from Millersburg, Ind., 18 miles east of Elkhart, to Nasby Tower, about four miles west of Toledo, a distance of 111.31 miles, was traversed in one hour, 27 minutes, equal to 76.76 miles an hour. The train consisted of seven steel cars, weighing about 940,900 lbs. and engine, No. 4853, weighing about 250 tons with its tender.

The War Department, through its sales organization, is preparing to sell in the condition in which it was prepared for military use, approximately 17,000,000 yards of cartridge cloth which can be processed and offered to the American public as a silk fabric suitable for dress goods, suitings, tapestries and other uses requiring a silk texture of heavy warp. The cartridge cloth thus offered is a gray, gummy material resembling burlap, but a simple process effects a wonderful transformation and the material comes out a smooth fabric of the color and texture of pongee or silk Palm Beach cloth, which will dye fast and print plainly.

There is a motor vehicle registered in the United States for every twenty-four persons; in Canada the proportion is probably one to each fifty; in England, one to two hundred; in Denmark, one to three hundred; and in France, Belgium, Holland, Switzerland, and Germany, about one to every four hundred. In 1917 it was estimated that Italy had one car to each 1,000 of the population; Portugal, to each 1,690; Spain, to each 1,900; Austria-Hungary, to each 2,650; and Russia, to each 5,000. In Australia there was one car for each 140 of the population, and in South America as a whole, one for each 1,430. Many a minor city in the United States has more cars than the whole of China or Japan.

A gypsum process of dry scouring wool is said to have been discovered in boys' play; that while the developer's sons were playing on the sands of the Almagorda Desert, their greasy clothes were cleaned as if my magic. On investigation and experiment it was developed that gypsum of a high degree of dehydration absorbs the moisture present in wool, chemically breaks down the fatty and heavier materials adhering to the fibres and removes them along with the moisture.

Excavation work in the north tube of the 14th St. rapid-transit tunnel under the East River, New York City, was completed Aug. 7, when the last piece of rock between the tunnel headings between Brooklyn and Manhattan was shot away. The river section of the tunnel is 3,437 ft. between shafts. The top of the tunnel is 97 ft. below mean high water at the lowest point, while the bottom is 115 ft. The maximum pressure used in driving the tunnel was 39 lb.

One of the curious suggestions made in the Southwest for the saving of wheat at harvest is the use of vacuum cleaners of special size and construction. The idea is that machines of the proper construction could be run over the fields and gather up the loose heads of wheat where grasshoppers have eaten the stalks. In some cases 50 per cent. of the heads were lying on the ground as the result of this insect activity. Some farmers used close toothed rakes with more or less success. Others mowed the wheat and raked it up. It is possible the "vacuum harvester" is on the way.

Personal Intelligence

James H. Manning has been appointed assistant engineering manager for Stone & Webster. He joined the staff of Stone & Webster in 1910, and served as superintendent of construction on the Franklin, Verdi and White Salmon hydro-electric developments, besides preparing various engineering reports. He was later made head of the hydraulic division. In 1917 he became chief engineer of the American International Shipbuilding Corporation. Early in 1919 Mr. Manning was made consulting hydraulic engineer for Stone & Webster, and recently was appointed assistant engineering manager.

* * * *

W. Cromwell Gurney, president and general manager Gurney Foundry Co., Toronto, Ont., was overcome by an attack of heart trouble on Sept. 17 and died within a few minutes. He was the eldest son of the late Edward Gurney, founder of the Gurney Foundry Co. Last spring he suffered a severe attack of la grippe, which affected his heart, and he had not been in good health since. Mr. Gurney, who was in his 46th year, was born and educated in Toronto, and had been connected with the Gurney Foundry since he entered upon commercial activities.

* * * *

In recognition of services rendered to the Bound Brook Oil-less Bearing Co., Bound Brook, N. J., Harry J. Lindsley who has been Western sales manager for the past seven years, and William F. Jennings, who has been Eastern sales manager for the past five years, have been made vice-presidents of their company.

* * * *

Homer S. Morrison, formerly assistant superintendent of the steel plant of the Sharon Steel Hoop Co. at Lowellville, Ohio, has been appointed superintendent of the blooming and bar mills, succeeding William Parry, resigned.

* * * *

G. P. Goodman, who for several years has represented the Hisey-Wolf Machine Co. in the East, will join F. H. Niles & Co., Inc., on Oct. 1 to take charge of the portable tool department. F. H. Niles & Co. handles not only the Hisey-Wolf line of electric machine tools but the Canton pneumatic hammers and drills manufactured by the Pittsburgh Pneumatic Co. in the East. F. H. Crawford has been appointed secretary and J. E. Haetten sales manager.

* * * *

Cedric B. Smith has been appointed editor of *The Monad,* the official organ of the American Association of Engineers. Mr. Smith is a graduate in both arts and civil engineering from the University of Minnesota. His engineering experience has been with the Oregon Trunk Ry., the Great Northern Ry., the Chicago Great Western R. R., and the Pennsylvania Lines West of Pittsburgh. During the war he served as an officer with the 74th Artillery in the American Expeditionary Forces in France.

* * * *

John Kopf, formerly with the Bureau of Aircraft Production, Dayton, Ohio, has been appointed manager of the engineering department of the Duff Mfg. Co., N. S., Pittsburgh, manufacturer of lifting jacks and other specialties.

* * * *

L. G. Chase, formerly efficiency engineer of the Rosemary Manufacturing Co., Rosemary, N. C., has been appointed mechanical engineer of the Yarnall-Waring Company, Philadelphia.

* * * *

On October 1 the Birmingham (Ala.) office of the Chicago Pneumatic Tool Co. was moved to No. 1925 Fifth Avenue, North, that city. The company will maintain hereafter at that address a service station where will be carried a stock of their products.

* * * *

E. G. Buckwell, secretary and manager of sales of the Cleveland Twist Drill Co., Cleveland, has just returned from a three months' visit to England and the Continent where he has made a thorough trade investigation in conjunction with the European branch, the Cleveland Twist Drill Co. of Great Britain, Ltd., London.

* * * *

The Chicago Pneumatic Tool Company announces the appointment of Fred Gehbauer, as special Navy Yard representative with headquarters at their Philadelphia office, 1740 Market street.

* * * *

Harry Hodgman, for the last six years connected with Missouri River improvements as United States Assistant Engineer, with offices at Jefferson City, Mo., has been transferred to the Detroit River district. He will have charge, under the direction of Col. E. M. Markham, Corps of Engineers, U. S. A., of the widening of the Livingstone channel.

* * * *

Melville J. Collins has been named general superintendent of the Mahoming Valley Steel Co. at Niles, Ohio, succeeding William Lynch, resigned. Mr. Collins has been with the company since it was formed and was formerly in the operating department of the Empire mills at Niles of the Brier Hill Steel Co.

COMPRESSED AIR MAGAZINE

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W. L. SAUNDERS, *Editor*
FRANK RICHARDS, *Technical Editor* FRANCIS JUDSON TIETSORT, *Managing Editor.*
CHARLES A. HIRSCHBERG, *Business Manager.*

Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

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EFFICIENCY SOMETIMES HITS THE SUFFICIENCY MARK

MAN EFFICIENCY.

> *"Efficiency, like an invention, always comes to an individual, never to a committee, or to an organization, and the weakness of co-operative production is the undervaluation of the individual, the manager who develops efficiency in other men. In most spheres of action, and in the economic world in particular, some men are much more efficient than others. Such men possess more ability than the majority of their fellows and among this higher class there are varying degrees of efficiency. Modern industry has been developed through the invention of efficient machinery. Man efficiency, however, is today of far greater importance than the further development of efficiency in machinery, and the greatest problem before us today is not the further improvement of machinery, but the development of an increased efficiency in men."*
> —JAMES LOGAN.

ISN'T EFFICIENCY simply *wonderful?* Every eventide before donning the Marquisian night garment, one asks himself, "Have I been efficient today, or have I *failed?*" Hermione, protege of Mr. DON MARQUIS, may wind up a perfect day like that, after she and her "little group of serious thinkers" have taken up and disposed of efficiency.

Manufacturers, producing business men, fail to set themselves right on the subject so easily, and yet the correspondence schools and "institutes" and organizers and system experts and personnel pickers and commercial counsel are abroad in the land like a Mosaic cloud of locusts.

The older fashioned, more conservative business men, who pride themselves on being practical, become disturbed of countenance and usually listen with impatience when some young enthusiast begins to dilate on the subject of efficiency. The newer order of specially trained business man, who gets his foundation in a university course, revels, on the other hand in the subject of real or fancied efficiency until on occasion his views become of a sufficiency.

Somewhere between these two extremes there is no doubt to be had real efficiency that can be applied alike to business, professional and personal routine—without taking all the joy out of life and work. Efficiency as administered by its most efficient exponents, is not so hard to take if one does not attempt to swallow it all at one dose. It is a disciplinary and educational diversion that grows on one and is rather fun than a bore if one starts in on the courses of instruction before forty years have claimed him. Every year after that it seems to become more and more of a castor ile proposition.

One brief lesson a week is about all anybody can stand in efficiency, be he young or old. It is true, too true, what HARRINGTON EMERSON says, that "the hardest task of the man who, through study, research and experiment, finds new and better ways of doing things, is not to make his discoveries, but to get those who need them most to adopt and make use of them."

Mr. EMERSON has frequently found it necessary to plead the cause of the efficiency expert and in so doing he has stated some truths. For instance:

" 'Practical' advertising men ridicule the theories of those who have studied the physchological and optical principles, and the economic factors involved in advertising. Yet by the use of these very theories the greatest advertising successes of today are won."

He tells the story of a Chicago printer who was doing an annual business of $100,000, on which his profits were only $4,000. It was too little—he had to work too hard and too long to earn it. So he called in a cost specialist. As a result he did only a $50,000 business the next year, but his profits were $12,000, and his work was easier, with night overtime and worry eliminated. One can see where the customers probably paid for this particular efficiency somewhere along the route, but it surely must have filled a long felt want for the printer.

If one will let the efficiency chap talk long enough, even though one be determinedly "sot in his ways," his capitulation is certain. The popular magazines are full of efficiency fiction to prove it. Of course, as a last resort, one can always hire somebody to be efficient for him!

None need advice from others more than those unwilling to accept it just because they already know a little about the subject in hand. A *little* knowledge is indeed a dangerous thing. Mistaken sufficiency is not efficiency. We must step on our gas and become really efficient.

BURIED TREASURE SOUGHT BY ENGINEERING EDITORS

EDITORS of all engineering and technical publications are extremely likely to find themselves in accord with the editor of *Municipal and County Engineering*, who finds that much valuable data and information which never sees the light of day lies tucked away in drawers and cabinets, much of it forgotten. He observes that the engineering editor's idea of buried treasure may provoke a smile, but, understand, the editor has a right to his opinion, and, fortunately, he has the opportunity to express it. Since the editor deals in engineering literature it is only natural that his idea of the treasures of earth should pertain to the great unworked deposits of raw material of this sort which are known to exist, but which remain deeply buried in the engineer's brain or in his files. It is a very tantalizing thing to know that these gems lie at the dark, unfathomed bottoms of filing cabinets in all parts of the country and that all the persuasive powers of the editor are not sufficient to draw them out for useful purposes. What a melancholy thing it is to realize that many flowers of engineering eloquence or expression are but "born to blush unseen!"

Every month the editor goes prospecting around for these treasures. By keeping his sleeves well up at the elbow he manages to uncover a good deal of this material which assays sufficiently high to make its recovery well worth the effort involved. But always there remains regret that those who inter these treasures are so slow to exhume them.

PINS AND FORTUNES

E. H. HARRIMAN, the railroad wizard, died leaving behind him an estate valued at approximately $75,000,000, but he knew the value of trifles. One day he picked up a small steel letter clip dropped on the floor by a careless employee.

"I'd like to have as my annual income," said Mr. HARRIMAN, "the value of material thrown away every year by indifferent workers in the offices and factories of America. In a few years I'd be the richest man in the world."

Nor was Mr. HARRIMAN given to business exaggeration. His quick observation inevitably made him cognizant of universal waste in the indicated direction; his keen sense of financial values rated it closely. And the truth enunciated by the railroad financier and magnate by the ordinary man or woman of business may be attested at every turn of the eye.

A Chicago business man not long ago cast about in his mind for ways and means of saving money for a special and specially desired avenue of business increase. An experienced adviser suggested looking after the "small leaks." The business man, recognizing the wisdom of such suggestion, looked over his plant quietly but sharply. He was shocked at the continual waste going on all about him. Sheets of paper on which only a few words had been written thrown into the waste basket instead of being used for making notes or similar "scratch pad" purpose. Pins, clips, rubber bands, blotters, erasers dropped on the floor and never recovered. Ink and mucilage bottles, carelessly set down, tipped over. Typewriters left uncovered, undusted, with unwarranted repair bills in consequence. Electric lights left burning when not in use.

The employer meditated, took action, made an interesting announcement. The office boy turning in to him the greatest number of salvaged articles in good condition at the end of the week would receive a Thrift Stamp for every 50. The boy with the largest month's salvage record would find a War Savings Stamp in his pay envelope. The offer would be repeated from month to month.

The offer didn't amount to much after the first few weeks because it impressed such a good lesson. At the end of the first month, despite the extra care of the wondering clerical employees, the employer's exhibit served as text of a terse little sermon that set all the office force thinking—and saving.

One should not be ashamed to practice care in small matters. Waste of any sort is criminal. Being careful means being successful. It may save or start a fortune in the long run when you stoop to pick up that stray pin.

SCHOOP PERFECTING HIS METAL SPRAY PISTOL

WITH FURTHER reference to our editorial in the June, 1919, edition respecting the use of the metal spraying or plating pistol in Germany during the war for the conservation of copper, nickel and other metals scarce at the time, which commentary attracted wide attention in this country and in England, we observe that M. Schoop of Switzerland, inventor of the method of metal spraying by air, has issued a statement made public in the English press.

Mr. Schoop states that he is now engaged in working out further details of his new electrical spraying process, by means of which molten metal is applied with an electric spraying pistol. The promising results so far obtained, and the apparatus already constructed, lead him to anticipate that in the near future it will be possible to supply single electric spraying pistols, which may be connected on to any electric circuit.

In the new type of apparatus the metal is smelted by electricity (40 amperes at 30 volts) and not by compound gases, and the method of procedure is so different from the old one that a remarkable improvement of the method may be expected.

HOW TWO BROTHERS SAVED THE DAY FOR ITALY

A TYPE of the foreign delegates selected by England, France, Italy and Belgium to meet business men of America at the International Trade Conference in Atlantic City late in October, is to be found in Frank A. Vanderlip's new book, "What Happened in Europe"—Pio Perrone of the great Ansaldo Company, at Genoa. Mr. Vanderlip says:

"When the father of the Perrone Brothers died, the two sons, with a touch of Italian romanticism, stood at the bier and made a stern compact one with the other that they would never admit German capital into their great industrial inheritance. At the outbreak of the war it and various subsidiaries had become stock companies, the whole group being generally known as the Ansaldo Company, and it had great and varied industrial capacity, running through shipbuilding, the making of turbines, the construction of locomotives and the building of electrical machinery.

"With Italy's entrance into the war these two men had the imagination to realize that the Great War was a war of industrial capacity. They offered at once to turn their establishment into the making of large guns for the army. They got no orders for guns. Lack of orders, however, did not daunt them. They secured from Italy's Allies the designs of the most efficient French guns and without a single order from the Government, and in the very first days of the war, they started to convert their plant into an ordnance establishment. Before they had reached an order for a single gun they had completed 2,000 pieces of ordnance.

"Then came the Caperetto disaster. And not until that awful defeat did the Italian Government turn to them with cries for guns. When the first order was placed, the officials were confounded on being told that the guns were ready for immediate delivery. These two thousand guns were at once put in the field to take the place of the vast losses which the Italian army had sustained, and furnished Italy a service in stopping the advance of the Austrians the value of which can hardly be measured. The Ansaldo Company could now get orders, but they could not get pay. The orders were unceasing. The pay continued elusive. The great works, however, were operated to their utmost capacity, and performed a feat at which those in America who know by experience the difficulties of ordnance production will marvel. Works that employed one hundred thousand men were created and ten thousand guns were put in the field. At one time the Italian Government owed the Ansaldo organization 700,000,000 lire.

"In a struggle balanced to such a nicety as was the Great War; when Paris was saved and perhaps the whole cause saved by the opportune arrival of a handful of Americans at Chateau-Thierry, it can be justly said of each of many factors that the war could not have been won without this or that particular contribution. In that sense it seems to me it can truly be said that without the contribution of the Perroni Brothers, and of their industrial organization of a hundred thousand men they brought together in the Ansaldo works, the Great War could not have been won. For Italy's cause would have been lost, and with that loss might have come the downfall of the great cause."

U. S. TO HAVE MERCHANT FLEET OF 25,000,000 DWT. TONS

ANNOUNCEMENT was made by the United States Shipping Board in the middle of September concerning the actual tonnage of the United States in merchant marine service. While the building activities of the Emergency Fleet Corporation have been largely curtailed since the signing of the armistice a year ago, this country has made a formidable showing in the world shipping lists and in shipbuilding. We are again serious contenders in deep sea commerce carried in our own bottoms. The completion of the government construction contracts which were not cancelled, and the building for private account which will follow at many of the big yards, will further improve our position in the next few years.

The Shipping Board had completed construction, up to August 29, 1919, of 6,420,701 deadweight tons of steel, wood and composite ships; seized from Germany and Austria 607,502 tons; purchased from Japan and Australia 158,326 tons and requisitioned from private owners 519,870 tons, a total of 1,280 ships of 7,706,240 deadweight tonnage. These figures do not include 122 steel ships of 465,745 deadweight tons and 63 wooden ships of 246,982 deadweight tons sold recently to private owners, mostly foreign, nor does it take in seized vessels that had been sunk.

Mr. Walter Scott Meriwether, Manager of the Information Bureau of the Shipping Board, for many years widely known as "Skipper" Meriwether, ship news writer for New York dailies, states in his comprehensive report that America's rapid advance from an inconsequential place among the maritime nations to the post of leadership in shipbuilding, was not only phenomenal but is a fair augury for the permanence of its new merchant marine, built under the stress of war.

At the outbreak of the world struggle, merchant marine construction had almost become a lost art in this country. Today this nation has more shipworkers, more shipyards, more shipways, more vessels under construction, and is turning them out more rapidly and in greater numbers than now issue from all the shipyards of all the rest of the world combined.

As the premier shipbuilding nation of the world America attained her place in one giant stride. Up to the outbreak of the war we had only 15 vessels of 1,000 tons and over engaged in oversea trade. Today the American flag floats from 1,280 ocean going steamships, 1107 of which had been built by the United States Shipping Board within the last two years.

In June, 1914, the total gross tonnage under the American flag, including coastwise shipping and the fleet operating on the Great Lakes, was 4,287,000 tons. In June, 1919, its gross tonnage was 11,983,000, an inrcease of 278 per cent., chiefly in ocean going steamships.

The steam tonnage under the American flag is now 24.8 per cent. of the steam tonnage of the world. The world steam tonnage of 100 gross tons and over on June 30, 1919, as reported by Lloyds, was 24,386 vessels of 71,845,500 dwt. tonnage. American steam tonnage of 100 gross tons and over on June 30, 1919, including tonnage on Great Lakes, was 3,687 vessels of 17,974,500 dwt. tonnage.

The per cent. of world steam tonnage of 100 tons and over under the United States flag on June 30, 1919, was 15.1 and the per cent. of tonnage was 24.8. These percentage figures include tonnage on the Great Lakes.

In the four years preceding the war, the shipyards of this country turned out a total of 107 seagoing vessels of 1,500 tons and over, chiefly coastwise. This construction represented 805,037 deadweight tons.

During 1918, a period when the Shipping Board was getting into its stride, there were launched from the yards under its control a total of 4,216,656 deadweight tons, five times more than had been built in the four pre-war years. During the year 1918, shipyards under control of the Shipping Board, delivered 3,107,093 deadweight tons of completed ships.

From January 1, 1919, to August 29, 1919, 3,983,135 deadweight tons of shipping were launched, and 3,845,140 deadweight tons delivered; a total for the twenty months (since the beginning of 1918) of 8,199,791 tons launched and 6,952,233 delivered.

The original construction program contemplated the building in this country of 17,807,071 deadweight tons of shipping; 2,105 steel steamships of 14,351,971 deadweight tons, 1017 wood steamships of 2,978,100 deadweight tons, 50 composite ships of 175,000 deadweight tons and 43 concrete ships of 302,000 deadweight tons, a total of 3,215 ships.

Steamships to the number of 408 and aggregating 1,920,724 in tonnage are being fitted out in wet basins at this writing. On the ways are 389 steel steamships of 3,015,605 dwt. tons; 99 wooden steamships of 207,000 dwt. tons; 9 concrete steamships of 63,500 dwt. tons. Then in addition to these already under construction there are still to come 227 steel steamships of 1,476,610 dwt. tons which have been contracted for, but upon which work has not yet been begun.

Including completion of vessels launched, but not delivered, completion of vessels for which keels have been laid and completion of vessels under contract, there is still to be delivered a total of 6,683,439 dwt. tonnage in ships. When this fleet is added to our existing steam tonnage, including that of the Great Lakes, America will be in possession of a great fleet aggregating nearly 25,000,000 deadweight tons.

It is interesting to note that the seagoing personnel under the control of the United States Shipping Board now numbers some 51,560 men, of which 4,592 are deck officers and 4,592 engineer officers.

EMINENT ARMY ENGINEER JOINS U. S. SHIPPING BOARD

The United States Shipping Board has announced the appointment of Colonel E. H. Abadie as Comptroller of the Division of Operations, in place of John J. Nevin, resigned. Colonel Abadie joined the United States Army June, 1917, as a Major of Engineers and subsequently entered the Construction Division as Supervising Constructor. As such he had personal supervision of Camps Funston, Dodge and Lee and entire direction of construction and administration of the Augusta (Ga.) Arsenal Depot, the mechanical repairs shops at Camps Normoyle, Texas, and Holabird, Md., also of the General Army Hospitals at Biltmore, Azalia, Waynesville, Hot Springs and Denver, the War Prison Barracks at Atlanta and Fort McPherson and the Quartermaster's Depot at Atlanta. He was promoted to Lieutenant-Colonel, Quartermaster's Corps, Construction Division, in August, 1918.

Prior to his entrance into the army, he had been engaged in engineering work chiefly for municipalities, public service commissions, large neering societies, the Society of the Colonial Wars, the Military Order of Foreign Wars and of the important clubs of St. Louis, his home city. He was also Secretary and Treasurer of the Industrial Engineers' Corporation of that city.

Another change announced by the Shipping Board was the appointment of Alonzo Tweedale as Treasurer of the United States Shipping Board Emergency Fleet Corporation, vice Waldo S. Reed, resigned.

AIR MACHINERY EXPORTS

The Bureau of Foreign and Domestic Commerce of the Department of Commerce has provided to us for publication the following table of exports from the United States of air compressing machinery, by countries, for July, 1919:

Countries	*Dollars*
Belgium	913
Denmark	1.840
France	34.833
Italy	6
Norway	211
Spain	8,165
Sweden	923
England	41.129
Canada	19.602
Mexico	7.004
Cuba	6.741
Haiti	346
Argentina	840
Bolivia	5.135
Brazil	15,276
Chile	2,597
Colombia	40
Peru	7.201
Uruguay	18.007
China	6.404
Dutch East Indies	11,599
Japan	370
Siam	100
Australia	208
Philippine Islands	5,255
British South Africa	2,044
Total	196,789

A new use has been discovered for gas masks. Word comes from Indiana that these masks are in demand for threshing and shipping wheat infected with Australian take-all. All grain is so saturated with formaldehyde that the workers cannot stand the fumes.

DEATH OF A GREAT TUNNEL ENGINEER

Charles Mathias Jacobs, whose specialty was subaqueous tunnel construction, and to whom New York City was indebted as to no other man, excepting Alfred Noble, for the successful solution of its phenomenally difficult tunnel problems and the establishment of tunnel building upon a secure basis, died in London on Sept. 7, in his 70th year. It will be remembered that Alfred Noble also died at the age of 70, five years ago.

Jacobs was born at Hull, Yorkshire, and was liberally educated. After leaving Cambridge he acquired a practical knowledge of his profession in the shops of Charles and William Earle, engineers and shipbuilders of his native city. He seems to have adopted his specialty—or perhaps his specialty had adopted him—from the beginning. He became an independent engineer and before the age of 40 he had a wide reputation as an expert in subaqueous and marine engineering. He came to this country in 1889 to become the general advisor of Austin Corbin, then President of the Long Island Railroad, for the carrying out of various plans for the development of New York's rapid transit schemes, which arangement collapsed with the death of Mr. Corbin.

The first of all the river tunnels of New York was that of the East River Gas Company, for carrying large gas pipes from Ravenswood, L. I., to Seventy-first Street, Manhattan. This was started in solid rock from both ends and was expected to be of the same character for the entire distance. A depression of the rock surface under the channel left only soft river debris to be penetrated and under the original contractors the work came to a standstill after several fatalities. Mr. Jacobs drove the work to completion, in its progress solving novel and most difficult problems, developing the modern methods of tunneling under pneumatic pressure and placing the trade of the sandhog upon a basis of safety.

The so-called McAdoo tunnels under the North River had been an abandoned enterprise for several years after a catastrophe which cost many lives and left the work hopelessly flooded. Work here was taken up again and carried to complete success under the direction of Mr. Jacobs.

The building of the first twin tunnels for the Pennsylvania Railroad was a still more exacting undertaking which the previous experiences had led up to, in the developing of the system of working and the providing of most necessary devices both for safety and for celerity and economy of operation.

In connection with the planning and construction of these tunnels one most serious problem was ingeniously solved in anticipation of serious trouble to be experienced, but the application of it proved to be uncalled for and a considerable additional expense was saved. Although the McAdoo tunnels had proved sufficiently stable in service, it was feared that with the heavy trains traversing the Pennsylvania tunnels there would be sinkings or fluctuations up and down of the tubes in the soft and yielding semi-fluid material surrounding them, and accordingly as the tunneling progressed and the cast-iron lining was placed large holes were provided at frequent intervals in the bottom of the tube for the insertion of screw-piles made in sections and of considerable length which would serve as anchors and assure the required vertical stability. The screw-piles eventually were not required, but the record of the device attests the ready resource of this great tunnel engineer.

Since the completion of the tunnels above mentioned, with the difficulties they solved and the methods and resources they developed the building of subaqueous tunnels at New York or elsewhere has become merely an affair of time and money with the insuperable difficulties forgotten.

Mr. Jacobs had been the senior member of the firm of Jacobs & Davies from which he had retired. A later engagement was under the French Government for constructing a tunnel under the Seine on a line connecting Havre and Rouen. He was a member of many engineering societies both of this country and England, of the Engineers' and Railroad Clubs of New York and London and of the Royal Societies and Automobile Clubs of London.

Speaking on Progress of Aviation in the War Period before the Royal Aeronautical Society recently, Dr. Leonard Bairstow said that the speed of aeroplanes had increased from 85 miles per hour to 135 miles per hour in five years, and some further improvement might be expected in the future. No equal addition to the speed range was probable, and economy suggested a reduction. It was not possible to decide from a single estimate of the value of speed in civil aviation, but for fighting it was the last reserve of superiority, which was all important.

The Chester Shipbuilding Company, Ltd., Chester, Pa., a subsidiary of the Merchant Shipbuilding Corporation, Harriman, Pa., has been closing a contract for two large tankers. Details regarding these vessels have not been announced at this writing.

Buenos Aires

A SCENTSASHUNAL COON HUNT

By the Hive Farm Boys, Monroe, N. Y.

Done into unfamiliar Latin Satire

By HENRY WELLINGTON WACK

'Twas a nox most opportunum
For moon hunting brindle coonum
With old canis, all a frettum
With his pesky fleas from Ghettom.
Scratched he then no more his belly;
But with eye alight with hell, he
Animabit fierce with growling,
Started coonward—sniffing, prowling,
As with aqua fortis gaited
And by coon-scent animated!

Luna lit her Lux on Mundus
With a Lux quid est profundis.
Pater, mater, all somnolens
In farm domo, snorem volens,
Heard no sonam noctis Bratti,
Nor of caterwauling catti.
Nox was quiet and right boonum
When we tres venit for coonum.

Verdant field near pomme de terrier
Locum est for creatures merrier
In the noctem than the morning—
Creatures Sol lux always scorning.
There our bonus bravus canis
Spied a hole in wild terrainis,
When his muzzle said, with worry,
"Now for bellum in a hurry!"
So with tail-piece all erectum—
We and canis hold inspectum.

Salutated we with clubsticks
And with divers farm-boy mean tricks,
Coon hole there upon the hillside,
Where old canis—nose all inside—
Cussed young coonum to come hither;
And cute coonum, coming hither,
Handed canis feline bellum,
Sprayed him then with scent like hellum—
Avec Polecatine de Rose—
Gas that partibust Brat's nose!

Bratti, Canis,
Skunkus fugit.

Hic now finis coonum fandi,
Hic we longed for poni brandi
To revive young Bratti's senses,
Lost to skunkus false pretenses.
Oh such tang, skunked Bratti scattered
And the swats old pater battered
On the pants of smelly Bratti,
Yowling now like hellish catti.
Nevermore, with tails erectum,
Will we tres-strange holes inspectum!

MORAL

The world hath many holes, you see,
That are not what they seem to be!

A diurnal colyumnist declares that if the human race hadn't got kicked out of the Garden of Eden it would never have had the sense to invent machinery, but we don't see what this has to do with the price of wheat. Possibly he means that every boost is a help.

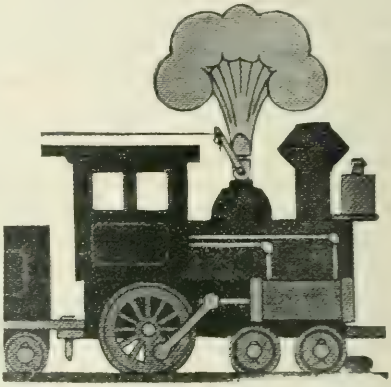
A REAL SPEED DEMON

It is his indomitable sense of humor that has kept him up. He has the worst fracture in the ward. But he knows cars from Alfalfa to Omaha, as O. Henry would observe. Gasoline is his middle name. When they put a frame over the foot of his bed to keep the covers from touching his leg the white sheets formed a hood unmistakably, and it was a long, low racing car—white with gold trimmings—"the kind ya drive sittin' on the back o' ya neck," he explained. He was challenging De Palma at Indianapolis. Humoring him, the Red Cross man brought him a klaxon, whose stentorian presence caused more than one nurse that passed his bed to stop suddenly and, clutching her medicine bottles, look quickly about her with scared eyes, to the huge amusement of the ward.

"Little girls like you oughtn't to cross the street all by y'r lonely, where nasty automobiles can run over ya!" he teased.

The make believe chariot varies with his humor. Sometimes it is a Ford bouncing over tortuous roads, or it's a Rolls-Royce, absolutely!

Ward No. 7 will be dull when he goes, even if the klaxon does bring down anathemas upon his head.



A SATURDAY EVENING POST LOCOMOTIVE—FOR DECORATIVE PURPOSES ONLY. EVEN COMPRESSED AIR COULDN'T MAKE IT WORK.

THE PROFITEERS

Twain butchers kin,
  Styled Bone & Skin,
Would starve poor folk, or near it;
  But be it known
To Skin & Bone
  That flesh and blood won't bear it.
The Profiteered.

PHILOSOPHY AND FOOLISHNESS

An optimist is one who can slip on a banana peel and repeat the Lord's Prayer.

Some men are born with black eyes and others have to put up a scrap to get them.

The fellow we know who never makes good on his word has as his motto, "It's a stingy guy that won't promise you something."

Sign in a millinery shop: "WANTED—Milliners to trim rough sailors."

The chap who gives away his friends usually hasn't any to spare.

Do you ever spend anything but the evening?

SKIMMED MILK

I cannot sing the old songs,
  I'm very weak on rhyme,
The sturdy, manly, bold songs,
  I have no sense of time.
And so I write vers libres,
  Where latitude's immense,
And sell them, too—indeed, I do—
  For sense.

I cannot make a sonnet
  However much I try,
Nor rhyme, my word upon it,
  An ode, though I should die.
So I indite vers libres,
  Dark, passionate, intense,
Nor do they fail to find a sale
  For cents.

W. W. WHITELOCK.

It is often proper to enquire the reasons for the *doing* of things; but nobody doesn't never need to tell nobody no reason for *not* doing nothing.

EXTRA! VICTORY! VICTORY!

The subjoined exact extract from an Italian wine dealer's circular, printed in Italian, and with this translation into "English," should not be withheld from distribution throughout an arid world. With utmost impartiality we have already send it along to a couple of newspaper colyum conductors in New York just to test their selfishness when in possession of such valuable information. Bunny has read it and he declares that, if you cut out the five words preceding "full of LIQUORS AND CORDIALS," you probably have the situation in a nutshell.

VICTORY

The strenght of intellect, the wonderful human brain—with which the man lives—thought, overthrow—destroy—discover and create—even this time as song VICTORY!! Yes, VICTORY! because, has an eagle dominating the highest mountains, flying on top of all the laws more or less logic, more or less incostitutional, as hallered with all his strenght, as the greatest warrior:

VICTORY! VICTORY! thou shall not pass!

So to day I sing victory, for I am opening a new rich store full of
LIQUORS AND CORDIALS
that no prohibition law can stop me sell in bottles or in cases.

These Liquors and Cordials are not alcholic, and they are assorted in different varieties. They are put up very elegantly. They can be used on any swell dinners, Weddings, or Christenings.

The prices are moderate, and I make reductions in case lots, of twelve bottles.

HOW TO BE A HAPPY REFORMER

For every evil under the sun
There is a remedy, or there's none;
If there is one, try and find it,
If there's not, then never mind it!

PREACHMENTS

Don't be afraid to act upon your good impulses. They are like muscles; if you don't put them to use, soon you will not have any.

* * * *

The gaining of applause should be left to actors and politicians; with other folk it is a weakness.

* * * *

Salary is frequently the small end of the compensation for the job; it is, if the person drawing it has the right stuff in him. And the more he takes his compensation in earning appreciation the more his salary will grow.

* * * *

The man that renders noble service to mankind is rich, even if he dies penniless. Future generations will erect his monument in marble or in books.

The Oracle.

TOO FAST FOR BROADWAY

He ran so long, and ran so fast,
No wonder he ran out at last;
He ran in debt—and then, to pay,
He beat 'em all, and ran away.

Shipyard Sam says: I was chinnin' with a politician who was down here to a launchin' last week, and says he to me, "What is the secret of the great success attained by the type of vessel you construct here?"

Said I, very bluntly: "Fabrication."

And he replied in a surprised manner, "What a coincidence! That is also the secret of my success!"

Bawmie Inthebean.

CONFIDENTIAL EMPLOYMENT BUREAU

NOTE—Advertisements under either of the classifications below will be numbered in the order of receipt and published free of charge, for the benefit of readers, in the next issue after date. All applications for the use of this convenience should be directed, "Confidential Employment Bureau," Compressed Air Magazine, Bowling Green Building, New York City. Replies to advertisements will be forwarded to the person or persons concerned.

POSITIONS WANTED

No. 861—Wanted position as mining captain by man of extensive experience in all methods of mining in flat and inclined seams. Can produce excellent reference as well as mining certificates as superintendent issued by the British Goverment.

No. 862—Position as draftman wanted by man with four years' experience in the Drafting Dept. of a large American shipbuilder. Can give best of references. At present employed but seeking opportunity holding greater prospects for the future.

No. 863—Superintendent of a large gray iron foundry will be available for connection on January 1. Familiar with modern methods and foundry practice. Full particulars requested in first letter.

No. 864—Superintendent of erection on structural work both bridge and building, seeking connection where there is an opportunity for investment in some good thriving erection company.

HELP WANTED

No. 433—Foreman required to take charge of detail room of a middle west manufacturer of high grade appliances. Give full particulars as to qualifications, reference, remuneration and present connection.

No. 434—Wanted by a New England textile mill—a superintendent especially familiar with modern textile machinery. A going plant requiring some modernization. Give full particulars in first letter.

No. 435—Foreman sought for repair department of a Pennsylvania coal mine. Must be familiar with repair work of all kinds, having had experience with above and below ground qeuipment. A knowledge of electricity desirable.

The Fuels Section of the Bureau of Mines is now engaged in an investigation of what actually happens in the combustion space of a powdered-coal-burning furnace, with particular reference to the ash disposal and furnace maintenance.

According to the United States Geological Survey, shaft 3 of the Tamarack mine, Houghton County, Michigan, is the deepest mine in the world, with a depth of 5,200 ft. Other shafts of the Tamarack and of the Calumet and Hecla mine in the Lake Superior region reach depths of between 4,000 and 5,000 ft. Three shafts of the Prizbram silver mines, Austria, have penetrated to depths of 3,300 ft. The Victoria quartz mine, at Bendigo, Australia, is 4,300 ft. deep, and a number of shafts in the Transvaal gold region have been sunk to depths of nearly 4,000 feet.

The U. S. Bureau of Mines has notified the National Coal Association that it will be unable to enforce the law governing regulation of explosives. Lack of funds is given as the reason.

Books and Writers

LUMBER MANUFACTURING ACCOUNTS, by Arthur F. Jones, Associate of the Institute of Chartered Accountants. Second printing. With tables and charts. Price $2, net. New York: The Ronald Press Company.

AS MR. JONES explains, this treatise on lumber accounting, applies primarily to what may be termed commercial lumber; such as is produced from the vast forest areas in the South, Middlewest and Northwest of the United States, and in Western Canada. Any system, he observes, devised for "hard" or "precious" woods, would be somewhat more elaborate; for, in proportion as the commodity dealt in becomes more valuable, it must be more carefully guarded. This applies, however, more particularly to statistical records as distinguished from accounting.

For years lumber accounting has been hampered by the fact that there is no uniformity of opinion among lumbermen or accountants with regard to certain essential features of the business, such as the treatment of interest and taxes on temporarily unproductive forest areas (now under discussion at Washington as potential food-producing land), the price at which a lumber inventory should be valued, and the definition of the true lumber cost. In his own volume the author puts forth methods that are at least debatable and ideas that he admits are opinionative, but he treated his subject in such a way that the adoption of a definite basis was necessary. The principle of "cost" has been maintained throughout, regardless of the author's own views. The use of technical terms is avoided as far as possible, and those that appear are either immediately explained or may be found in the glossary.

The book takes one back to a day when he was a lumber "accountant," twenty-eight years ago in the final heyday of Michigan lumbering, when he toiled from early morn to dewy eve on top of great lumber piles, deposited by lake schooners, in tallying millions of feet of pine. One still remembers with a little thrill how the boss commended the tallying of one shipload to within 500 feet on a million foot shipment and added a bonus of fifty cents to the weekly wage of $4.50. La, la! Times, methods and prices have changed. A dime would buy in lumber in those days what costs one of our shrunken dollars today.

DRAFTING, an "Opportunity Monograph" of Vocational Rehabilitation Series No. 29 prepared by the Federal Board for Vocational Education and issued in co-operation with the Surgeon General, War Department, and the Bureau of Medicine and Surgery, Navy Department. This is one of a series of works for the disabled soldiers, sailor, or marine, to aid him in choosing a vocation. It treats of mechanical drawing, mechanism and machine design, tinsmithing, sheet-metal drafting, architectural drafting, hydrographic and topographic drafting, ship drafting, patent drafting, commercial and other drafting and lettering. It is issued free and may be obtained by addressing H. L. Smith, Chief Rehabilitation Division, Federal Board for Vocational Education, Washington, D. C. Washington: Government Printing Office.

ELECTRIC WELDING, another Opportunity Monograph of Rehabilitation Series No. 40, issued under the same auspices as above. Washington: Government Printing Office.

READJUSTMENT AND RECONSTRUCTION ACTIVITIES IN FOREIGN COUNTRIES, being Vol. 1 of Readjustment and Reconstruction Information issued by the United States Council of National Defense, Herbert N. Shenton, Chief. Manufacturers and other business men engaged in foreign trade will find this pamphlet of decided value. The edition is restricted because of lack of funds. One copy has been sent to each Chamber of Commerce in the United States and two copies to libraries, the remaining distribution being to editors of technical journals. Business houses may avail themselves of the valuable data it contains at the places mentioned. Washington: Government Printing Office.

NEW MINING TREATISES

The Bureau of Mines of the Department of the Interior announces the following new publications (List 69) of interest to readers of this periodical:

BULLETINS

BULLETIN 165. Bibliography of petroleum and allied substances in 1916, by E. H. Burroughs. 1919. 159 pp.

BULLETIN 176. Recent developments in the absorption process for recovering gasoline from natural gas, by W. P. Dykema. 1919. 90 pp., 20 pls., 30 figs.

BULLETIN 178-A. War gas investigations of the Bureau of Mines, by Van. H. Manning. 1919. 39 pp.

TECHNICAL PAPERS

TECHNICAL PAPER 212. The determination of combustible matter in silicate and carbonate rocks, by A. C. Fieldner, W. A. Selvig, and G. B. Taylor. 1919. 22 pp., 1 fig.

TECHNICAL PAPER 216. Vitiation of garage air by automobile exhaust gases, by G. A. Burrell and A. W. Gauger. 1919. 12 pp. See review.

TECHNICAL PAPER 217. Saving coal in steam power plants, by U. S. Fuel Administration. 1919. 8 pp., 1 fig.

TECHNICAL PAPER 224. Metal-mine accidents in the United States during the calendar year 1917, by A. H. Fay. 1919. 80 pp.

The Norman W. Henley Publishing Company of New York has issued recently its new catalogue of practical and mechanical books for the benefit of engineers, superintendents, mechanics in general, and students. The catalogue will be sent to inquirers on receipt of request.

THE CARNEGIE PARADOX

By FRANK RICHARDS

I DO NOT see why it is not eminently proper, not to say considerably obligatory, for not only the newspapers of the day but also the specialized press, and particularly the publications devoted to engineering and industrial matters to give extensive space to the chronicling and consideration of a most notable event of even these epochal times, which the death of Andrew Carnegie must certainly be considered; and so I take the liberty of submitting a few of my personal cogitations as a small contribution to the general outspeaking which the occasion calls for.

While, as I here suggest, and as all must concede, the death of Andrew Carnegie is an event which makes the broadest and strongest appeal to all civilized humanity, it is a singular fact that no one has habitually thought of him, no one thinks of him even now as first of all, if at all, a great man. There are many names of the present day which the self-appointed historians of the ages will place more prominently and carry further on their records; which, by the way, suggests the reliability and the intrinsic value of the historic estimate.

We were all sufficiently familiar with the personal appearance of the man, and we know that he did not look the great man, did not dress or carry himself as a great man, but was always in mien and act an ordinary man of the people, perhaps unusually well satisfied with himself, but still every man's equal and regarding every man as his equal. He was so closely in touch with the masses, and the masses felt so closely in touch with him that he has not usually been known or spoken of anywhere as *Mr.* Carnegie. He was just plain Andy to everybody, and with his full approval.

To all too many of us, to probably most of the world, Andy's supreme claim to regard and remembrance is in the single fact that he surpassed all the records as the direct, out and out, giver of money. It is not worth while to mention any figures, as there are no others with which to compare them. But the story of the phenomenal amount of his giving is only the beginning instead of the summing of the account. The manner and method of his giving was as exceptional as the amount of it. There was in the giving never any lack of appreciation of money values. There was never any giving as a result of reckless impulse. No dollar was slipped out with the mere hope that it might do somebody some good. His head and not his heart gave impulse and direction. When he went into the giving business he made a business of it, and conducted it upon the strictest business principles. The money was placed where it would be continuously working and producing results in the future, as in the libraries he founded and the various institutions which are to endure through the ages. He in his gifts required also the gifts or investments of others, who would thus be committed to the looking after the gifts and the maintenance of them in operative efficiency.

He was so determined that his money should not be wasted, but should be continuously making good after leaving his hands, that he made all his gifts during his active lifetime, so that he could see and be assured that the necessary conditions were fulfilled, instead of letting things go until after his death and then trusting to mercenary schemers for their final disposition. His gifts were thus true gifts and not compulsory leavings, and carry a suggestion of great opportunity too often ignored by those who have not the nerve to face the fact that they cannot carry their wealth any farther than they can carry their mortal flesh.

It is not worth while to go into any discussion as to whether Andy made the wisest possible use of his money after all. As to that there would be no limit to the diversity of opinion. His personal judgment was worth as much, and probably more than any other. He surely intended that his benevolence should beget beneficence, and did his utmost to make the planned results secure. We may conveniently assume and concede that he did the gratest possible amount of actual, practical good that his wisdom could dictate, and place him high upon a pedestal as a monumental philanthropist and so call his record closed for all the world to applaud and emulate.

But really this is not the biggest part of his life nor the thing most noteworthy. There was the making or the accumulating of the money preceding the giving of it, and when we come to that we may unhesitatingly assert as the paradox of his life that in the getting rather than in the giving of the money was the vastly greater and mightier achievement. Here we may say he was grandly successful without necessarily assuming for him a particle of benevolent intent. He may have been—which he wasn't—absolutely and entirely selfish and grasping in his business transactions, but in them, largely viewed, he did colossal good in spite of himself.

Not all accumulators of wealth, not all the founders of millionaire families, for instance, can have this truthfully said of them, for the ways and means of acquisition are various. It is not easy to see how he is a benefactor who grabs large holdings of land and sells it out in small parcels at ten times or a hundred times the price, even if it be for the homes of the masses. Andy was no mere buyer and seller, and only that, either of land, or of food, or of any of life's necessities. He was pre-eminently both a buyer and seller, but between the buying and the selling the values were transformed, so that though he could sell at multiplied prices the augmented values were there for the buyer.

Andy in his real life work was essentially a creator of values as things passed through his hands, and, as values come entirely from work, he was above all a maker of work, a discoverer of opportunity, an organizer and stimulator of industry, a provider of profitable employment, of the means of comfortable and hopeful and worthwhile living for, directly and indirectly, hundreds of thousands of workers who could never, never, have provided it for themselves. And the good which he thus did lives after him. The industries to which he gave such a big share are to keep whirling along still gathering headway through the ages, and the crowd of prosperous workers continually increasing.

And yet, after all, Andy was as far as may be from being a saint. "Woe be unto you when all men shall speak well of you." He dodged that curse all right. If ever there was a man to be execrated and villified and detested by any class of the community here, surely he must have been the man and the class must instinctively have recognized him. What could he have been but the supreme bugaboo to those who teach, and to the greater mass of unfortunates who swallow the teaching, that there is only a certain amount of work to be done in the world, any way, and that the schemes of the workers should be to do as little work as possible, individually and collectively, in order that there may be enough work for all that the pay for it may continually increase.

Andy steps out most opportunely now if "more pay for less work" is to win, for surely his record is all the other way. There could never be any doubt of his purpose to produce to the utmost, and he had a marvelous faculty and facility for not only selecting men of force and judgment and loyalty for the execution of his purposes, but also to quicken and liven them in their doing, and his impulse and guidance was operative not only upon the leaders with whom he was personally in touch, but through them it permeated to the bottom of the mass of his coworkers.

He was always ready with appreciation and compensation for work well done. It is easy for us to believe that he made half a hundred of millionaires at the top of his industries, but all the way down also his men must have been fairly if not liberally paid, far more numerously than in most industrial organizations, where the men grow old in the service.

RAPID DEVELOPMENT OF GAS COMPRESSION PRACTICE

Not more than five or six years ago, commercial gas compression plants consisted of the simplest forms of gas pumps, single-stage compressors and primitive cooling coils. The plants operated only on rich casing-head gas that would produce four to six gallons of condensate with a capacity of not more than 200,000 or 300,000 cubic feet daily.

At present plants are in operation treating from 6,000,000 to 9,000,000 cubic feet of gas daily, yielding as low as one gallon of condensate per 1,000 cu.ft., using pressures of 250 and 300 lb. per sq. in. in two stages of compression, with elaborate systems of cooling the gas with water before compression and after each stage of compression. In some plants the gas is further cooled—temperatures as low as 0 deg. F. are often obtained, causing the precipitation of nearly all the condensable fractions commercially valuable for making gasoline.

KEEPING SMOKESTACKS IN CONDITION

Owners of factories are usually interested in preventing the depreciation of their plant buildings and equipment by frequent painting, but they oftentimes are prone to forget to take corresponding precautions to insure the long life of their smokestacks. When rust puts a smoke stack out of business, it means putting up a new one and possibly the tie-up of the entire plant. Therefore, this important link in the equipment should be kept in good condition by painting about once every two years.

There is on the market a special smokestack paint which, drying to an enamel-like surface, prevents the metal of the stack from corroding as a result of exposure to moisture in the air and to gases in the smoke. It is also proof against the high temperatures to which stacks are subjected and may, if necessary, be applied when the stacks are hot. It is to the advantage of every mill owner to use this paint frequently to double the life of the smokestacks in his plant.

The Chicago Pneumatic Tool Company announces the removal of their Cincinnati Office from the Mercantile Building to the Walsh Building, Pearl and Vine Streets, where a service station with a complete stock of pneumatic tools, electric tools, air compressors, oil engines, rock drills, and repair parts will be maintained.

Trial of the Silencer Peri-Flammes Schneebeli

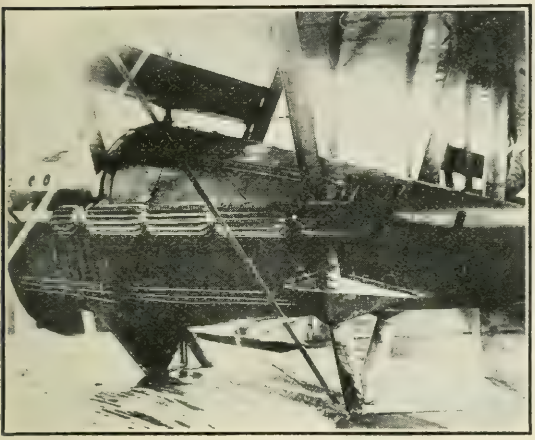


Photo Copyright Keystone View Co., N. Y.

THIS APPARATUS WHICH HAS JUST BEEN PURCHASED AND ADOPTED BY THE FRENCH ARMY REDUCES THE NOISE OF THE MOTOR AND SAVES THE FIRES BY RETURN OF THE FLAMES.

Latest U. S. Patents

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

AUGUST 5.

1,311,866. PROCESS OF AND APPARATUS FOR REMOVING SAND FROM HOLLOW DRILL-RODS AND THE LIKE. Percy A. E. Armstrong, Loudonville, N. Y.

1. The process of removing core sand from bores of tubular bodies which consists in forcing compressed air into the bore while confining same so as to discharge primarily against the sand adjacent to the bore walls and loosen it therefrom, and in removing the loosened sand.

1,311,930. STRAIGHT - AIR EMERGENCY-VALVE DEVICE. Walter V. Turner, Wilkinsburg, Pa.

1,311,959. MILKING-MACHINE. Peter A. Frimand, Wilmette, Ill.

1,311,973. PNEUMATIC SEPARATOR. William George Jonson, Abington, Mass.

1,311,922. FLUID-CURRENT METER. Fred M. Slater, Easton, Pa.

1,312,097. AUTOMATIC SIGNAL APPARATUS TO INDICATE FAILURE OF LUBRICATING SYSTEMS. Levi G. Buckner and Samuel J. Sibley, Memphis, Tenn.

1,312,117. ANESTHETIC-MACHINE. Jonathan G. E. Hinkle, Bethany, Mo.

7. In an anesthetic machine in combination, means for forming a solution of anesthetic vapor in air, a pipe for supplying pressure air to said means, connections for leading said solution to a patient, and a valve bypath between said pipe and the said connection so arranged that air may be delivered into said connection without passing through said means and while said vapor forming means is in action.

1,312,194. OPERATING AND CONTROLLING MECHANISM FOR PLAYER-PIANOS. Philip J. Meahl, Summit, N. J.

1,312,253. AUTOMATIC CONTROL DEVICE. Carl F. Johnson, Milwaukee, Wis.

1,312,286. APPARATUS FOR EXCLUDING DENSE FOG. Jukichi Tejima, Ube, and Keisuke Kishida, Toyohigashi Yamaguchi, Japan.

2. In a device of the character described the combination with a sighting tube, a standard upon which the sighting tube is adpustably mounted, an outer tube surrounding the sighting tube and spaced therefrom to provide an annular chamber which is mounted at the forward end of the sighting tube, a compressed air pipe in the standard, and a flexible tube connecting the compressed air pipe to the chamber of the outer tube, the air being ejected from the open end of the outer tube in a tubular jet which surrounds the line of sight and serves to exclude fog therefrom.

1,312,330. LUBRICATOR FOR AIR-COMPRESSORS. John P. Kelly, Pittsfield, Mass.

1,312,355. PNEUMATIC FOLDING ATTACHMENT FOR KEEPING DAMAGED VESSELS AFLOAT. John T. Reid, Lovelock, Nev.

1,312,357. AIR-BRAKE APPARATUS. Zala Riddle and Norman F. Wilkins, Dunsmuir, Calif.

1,312,484. APPARATUS FOR OZONE GENERATION. William John Knox, New York, N. Y., and John P. Mallett, Elizabeth, N. J.

1,312,495. PNEUMATIC ACTION FOR MUSICAL INSTRUMENTS. Morris S. Wright, Worcester, Mass.

AUGUST 12.

1,312,588. SUCTION AND PRESSURE CREATING APPARATUS. Benjamin Skidmore, Jr., Chicago, Ill.

1,312,615. METHOD OF AND APPARATUS FOR APPLYING FLUID-PRESSURE. Simon Cooper, New York, N. Y.

1,312,619. APPARATUS FOR TREATING PARTS OF THE HUMAN BODY. Isabel D'Orsay, New York, N. Y.

1. Apparatus for the treatment of the body comprising a pair of vacuum applicators adapted to be adjusted by the hands of the user, an exhaust pump, a mouth piece connected to the exhaust end of the pump, and auxiliary means for holding the vacuum.

1,312,642. COMPRESSED-AIR GREASE-GUN. Harry N. Niemann, Armstrong, Iowa.

1,312,649. FLUID-PRESSURE BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,312,650. PUMP-LUBRICATOR. Walter V. Turner, Wilkinsburg, Pa.

4. A lubricator for fluid compressors comprising a casing having a chamber containing a quantity of lubricant and having a passage leading from the space above the surface of the lubricant to the fluid compressing cylinder of the compressor, a fluid chamber having a passage communicating with the lubricant chamber below the surface of the lubricant and having a passage communicating with the fluid compressing cylinder, and a check valve for preventing back flow from the fluid chamber to the fluid compressing cylinder.

1,312,816. PNEUMATIC-CONVEYOR HOPPER. Louis C. Vanderlip, Elkhart, Ind.

1,312,948. AIR-MOISTENER. Eli J. Bushey, New York, N. Y.

1,313,030. ELECTROPNEUMATIC BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,313,160. PROCESS FOR COMPRESSING CHLORIN AND OTHER GASES. Leone Levi Bianchini, Rome, Italy.

1,313,203. SUCTION FLY-CATCHER. Harry Pakeman, Niles, Ohio.

1,313,205. GLASS-BLOWING APPARATUS. Harvey E. Quackenbush and Clinton L. Quackenbush, Bloomfield, N. J.

AUGUST 19.

1,313,306. SAND-BLAST MACHINE. William Henry Leiman and George William Leiman, Newark, N. J.

1,313,363. AIR-COOLED CONDENSER FOR REFRIGERATING-MACHINE. Edward Thompson Williams, New York, N. Y.

1,313,406. VACUUM-TUBEREPEATER. Robert C. Mathes, New York, N. Y.

1,313,533. LOW-PRESSURE ALARM FOR PNEUMATIC TUBES. William Andrew Harris, Greenville, S. C.

1,313,553. INFLATING-VALVE. Frederick Nielsen, Boston, Mass.

1,313,698. METHOD OF GENERATING PRESSURE. Alexander T. Kasley, Swissvale, Pa.

1,313,763. SHOCK-ABSORBER. Edmund P. Thomas, Centralia, Wash.

1,313,767. VALVE FOR AIR STARTER SYSTEMS. John F. Upton, Sapulpa, Okla.

1,213,842. AIR-MOTOR. Salvatore Tridico, Brooklyn, N. Y.

1,313,859. DRILLING APPARATUS. George H. Gilman, Claremont, N. H.

1,313,861. HOT-AIR DENTAL SYRINGE. James

Ernest Reid, Moorestown, and Frederick W. Side, Camden, N. J.

1,313,867. PISTON-CONTROLLING MECHANISM. Henry H. Mercer, Claremont, N. H.

AUGUST 26.

1,313,924. PNEUMATIC ARCH AND HEEL SUPPORT. Benjamin Stewart, Erie, Pa.

1,314,056. FUEL-CHARGE-SUPPLY APPARATUS. John Good, Brooklyn, N. Y.

1,314,153. LIQUID TRANSMISSION. Eugene Schneider, Paris, France.

1,314,163. PNEUMATIC ACTION FOR AUTOMATIC MUSICAL INSTRUMENTS. Selviyor A. Swanson, North Tonawanda, N. Y.

1,314,168. FLUID-PRESSURE BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,314,175. FURNACE FOR CONVERTING ENERGY OF FUEL INTO FORCE. Willet C. Wells and Frank E. Wells, Columbus, Ohio.

1. A furnace having means for supplying fuel thereto, means for admitting compressed air to support combustion therein, and means for admitting compressed air to be expanded therein by heat in bringing the gases of combustion to a serviceable temperature, said temperature automatically controlling both said means of admitting said air.

1,314,198. TRACK-SANDING DEVICE. Frederick D. McGinley and Thomas J. Coughlin, Syracuse, N. Y.

1,314,246. ROCK-DRILL. Omar E. Clark, Denver, Colo.

1,314,277. AIR-PUMP AND CLEANING DEVICE. Albert Loppacker, Bloomfield, N. J.

1,314,288. MOTOR. Daniel S. Waugh, Denver, Colo.

1,314,316. APPARATUS FOR SEPARATING ORE MATERIALS FROM EACH OTHER. Frederick B. Flinn, Orange, N. J.

1,314,342. PNEUMATIC ROLL. George A. Lawrence, Woburn, Mass.

1,314,360. AIR-COMPRESSOR. Gordon Phillips, Cobalt, Ontario, Canada.

1,314,409. VACUUM APPARATUS. Thomas McConnell, New Kensington, Pa.

1,314 443. AIR CLEANING ATTACHMENT FOR AIR-COMPRESSORS. Thomas E. Taylor, Kansas City, Mo.

1,314,473. INCUBATOR. Charles M. Heck, Raleigh, N. C.

1. In an incubator, the combination with an incubating chamber, of a warm air supply, a hot air supply, means for conducting air from said supplies to said chamber and discharging it above eggs or like producers of animal heat in said chamber, a thermostat positioned near said eggs, means for shielding said thermostat from the direct discharge of air from said supplies, and means operated by said thermostat to cut off one of said supplies and control the volume of air supplied by the other supply.

SEPTEMBER 2

1,314,539. AIR-LIFT PUMP. Frank P. Rust, Detroit, Mich.

1,314,553. COMPRESSED-AIR STARTING AND REVERSING DEVICE FOR INTERNAL-COMBUSTION ENGINES. Jonas Albert Weyland, Djursholm, Sweden.

1,314,564. AIR-FILTER FOR GAS-ENGINES. Frank Belleville and Edwin A. Belleville, Twin Falls, Idaho.

1,314,693. SUCTION CLEANING DEVICE. William V. Orr, Cleveland, Ohio.

1,314,740. APPARATUS FOR BURNING PULVERIZED FUEL. Charles J. Gadd, Lebanon, Pa.; Anna Eyre Gadd executrix of said Charles J. Gadd, deceased.

1. In a pulverized fuel burner, in combination, two co-axial air-carrying pipes, two co-axial discharge nozzles, one for each pipe and spaced ball-and-socket jointed connections between the nozzles and the respective pipes, providing for separate control of the contents of the two pipes, as far as the end of one of the nozzles.

1,314,773. APPARATUS FOR CHARGING CYLINDERS WITH OXYGEN. Max von Recklinghausen, New York, N. Y.

1,314,850. AIR-GUN DISCHARGE MEANS. Benjamin L. Blair, Indianapolis, Ind.

1,314,914. BLOWPIPE. Yosi Tamaki, Los Angeles, Calif.

1,319,919. GAS AND AIR MIXER. George P. Washburn, Los Angeles, Calif.

1,314,973-4-5-6-7. AIR-BRAKE APPARATUS. Spencer G. Neal, New York, N. Y.

1,315,065. AERIAL-NAVIGATION INSTRUMENT. Harry Egerton Wimperis, Goring, England.

1,315,089. AIR-PUMP. George L. Camfield and Vernon F. Shutt, Colorado Springs, Colo.

1,315,104. PNEUMATIC CONTROL APPARATUS FOR MOTOR-VEHICLES. Frank X. Ewald, La Salle, Ill.

1,315,164. SYRINGE. Oscar O. R. Schwidetzky, Hasbrouck Heights, N. J.

1,315,165. HOLDING MEANS FOR DRAIN-VALVES OF AIR-BRAKE SYSTEMS. Patrick M. Searson, Jersey City, N. J.

1,315,173. AUTOMATIC PRESSURE-RELIEF VALVE FOR PNEUMATIC TIRES. Luther Marion Wampler, Liberal, Kans.

SEPTEMBER 9

1,315,212. EXPRESSION-CONTROLLING DEVICE FOR PNEUMATIC PLAYERS. Frank J. Clark, Milwaukee, Wis.

1,315,233-4. ROTARY BLOWER. John T. Needham, Bayonne, N. J.

1,315,254. PROCESS AND APPARATUS FOR COOLING CEMENT-KILN GASES AND THE RECOVERY OF DUST THEREFROM. Levi Stevens, Alpena, Mich.

1,315,325. HOSE-TESTING DEVICE. Stuart A. Nims, Keene, N. H.

1,315,327. PRESSURE-GAGE. Josiah W. Place, Brooklyn, N. Y.

1,315,422. POWER-DRILL. John M. Roberson, Seattle, Wash.

1,315,433. MOTOR-DRIVEN COMPRESSOR. Lewis L. Tatum, Milwaukee, Wis.

1,315,482. NON-SLIP PNEUMATIC TREAD. Charles Francis Dyer, Brooklyn, N. Y.

1,315,517. HUMIDITY CONTROL. Arthur E. Krick, Indianapolis, Ind.

1,315,636. SELF-PLAYING MUSICAL SIREN-HORN. Joseph Papp, Revere, Mass.

1,315,719. APPARATUS FOR BURNING POWDERED COAL. Aubrey J. Grindle, Chicago, Ill.

1,315,765. SPRAYING DEVICE. Edmund Eckart, New Rochelle, N. Y.

1,315,772. APPARATUS FOR UTILIZING AN EXPANSIVE FORCE. Herbert Alfred Humphrey, London, England.

1,315,858. FLUID-PRESSURE INDICATOR. Josua Gabriel Paulin, Stockholm, Sweden.

1,315,871. COMBINATION AIR AND HAND POWER JACK. Lawrence R. Shadwick, Palestine, Ill.

1,315,882. PNEUMATIC CONTACT-FRAME. Emanuel W. Sweigard, Chicago, Ill.

1,315,931. MEANS FOR MIXING STEAM WITH AIR. Jan Hendrik Poppink, Tilburg, Netherlands.

SEPTEMBER 16

1,316,072. COW-MILKING MACHINE. Carl Oscar Anderson, Springfield, Ill.

1,316,073. HUMIDIFIER. James A. Andrews and John W. Herbert, Biddeford, Me.

1,316,077. PNEUMATIC-TUBE SYSTEM. John S. Black, Clayton, Mo.

1,316,139. AIR-COMPRESSOR. Horace M. Cake, Philadelphia, Pa.

1,316,144. AIR-FILTER. Austin O. Craven, Detroit, Mich.

1,316,164. FLUID-DRIVE MECHANISM FOR AUTOMOBILES. Milton A. Kettler, Washington, D. C.

1. In a fluid driving means for automobiles the combination of a rotary pump adapted to place the fluid under compression; a rotary power shaft for rotating said pump; a motor having rotary abutments adapted to be driven by said fluid; a connection between said pump and motor comprising driving and return passages and a plurality of channels in multiple within the casing of said motor; and rotary means adapted to cut off one or more of said channels to change the speed of said motor, substantially as described.

1,316,204-5-6-7. BRAKE SYSTEM. Walter V. Turner, Wilkinsburg, Pa.

1,316,340. SUCTION APPARATUS FOR SURGICAL USE. Albert H. Tuttle, Cambridge, Mass.

1,316,342. OZONE-GENERATOR. Albert E. Walden, Baltimore, Md.

1,316,417. AIR-PUMP FOR PNEUMATIC TIRES. Edward R. Buchanan, Paducah, Ky.

1,316,423. PNEUMATIC ARCH-SUPPORT. Rose S. Carling, Los Angeles, Calif.

1,316,442. VACUUM-CLEANER. Charles L. Goughnour, Pasadena, Calif.

1,316,445. APPARATUS FOR FIXATION OF ATMOSPHERIC NITROGEN. James Simpson Island, Hamilton, Ontario, Canada.

COMPRESSED AIR MAGAZINE

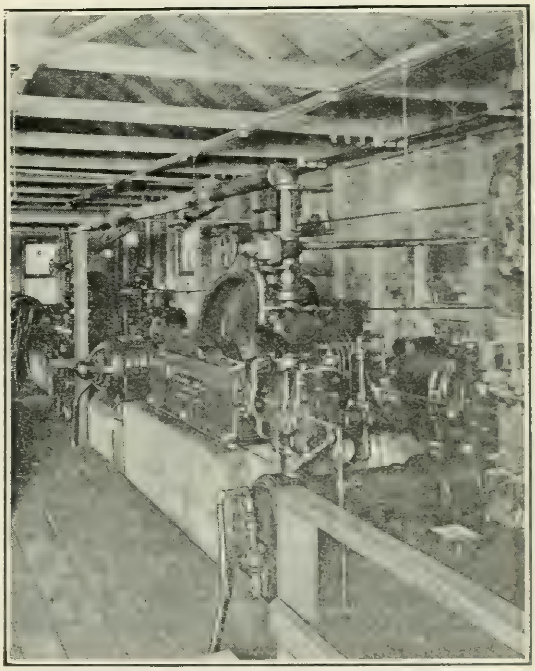
Vol. XXIV DECEMBER, 1919 No. XII

Rapid and Economical Sinking of a Great Mine Shaft

THIS SHAFT, known as the "H" shaft of the Pabst mine of the Oliver Iron Mining Company, Ironwood, Michigan, with outside dimensions of 18 ft. 4 in. by 11 ft. 4 in., and having when completed one cage compartment, 10 ft. by 5 ft. 8 in.; two skip compartments, each 5 ft. by 6 ft.; one pipe compartment, 3 ft. 8 in. by 5 ft. and one ladder compartment, 3 ft. 8 in. 5 ft., a vertical depth of 1,830 ft.—more than a third of a mile, and involving the removal of more than 14,000 cubic yards of rock—was begun on June 20, 1917, and completed in March, 1919, which means not merely that the above depth was reached but that the shaft was entirely ready for service from top to bottom.

When the work was started it had been decided to make each part of the job as complete as possible while the sinking proceeded, for it was believed that in the long run time would be saved by so doing, rather than to push the sinking first and complete the steel work and equipment later, so that as the shaft went down all steel sets, bearers, dividers, concrete lath and skip runners were placed, and, in addition, all stations were cut, pockets built, and cages and buckets put into operation. It is believed that the progress made was a record for the district, with no serious accident from start to finish. A clear and most satisfactory account of this work has been prepared by Mr. A. J. Wagner for *Engineering and Mining Journal,* his narrative being here reproduced with one or two added illustrations.

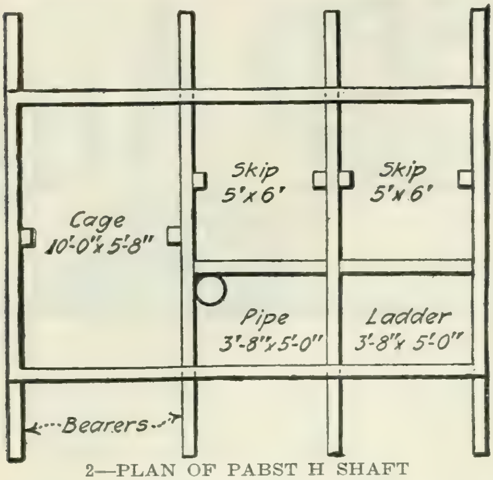
The long axis of the shaft was placed perpendicularly to the strike of the formation, taking the natural ground slippage on the end of the shaft. This is the first shaft so situated on the Gogebic Range. In sinking, the first nine feet was overburden, and this was followed by slate that continued to a depth of 725 ft. At this point granite was cut, and granite with dikes continues to the bottom of the shaft.



1—COMPRESSOR PLANT AT PABST MINE

The sinking crew consisted of eight miners and one shift boss on each of three eight-hour shifts, making a total of 27 men. These men performed all the work in the shaft, such as drilling, charging, blasting, mucking, and timbering.

The drill equipment at the beginning consisted of twelve Butterfly Jackhamers, Type BCR430, equipped with ⅞-in. hollow hexagon steel and four-point bits. These were used in the slates to a depth of 589 ft., at which point harder ground



2—PLAN OF PABST H SHAFT

required a stronger and heavier drill. Twelve Jackhamer sinkers, Type DDRW13, then replaced the Butterfly machines. The factor of primary importance in speed of sinking is to break the ground, and the remarkable accomplishment of the drilling machines used in the "H" shaft made possible the fast record. As will be detailed later, a nine-foot sink the full size of the shaft was drilled, charged, and blasted in eight hours, the actual drilling of the full round, totaling 442 ft., requiring from five to six hours. The drilling time from start to finish of a nine-foot hole in granite averaged thirty minutes.

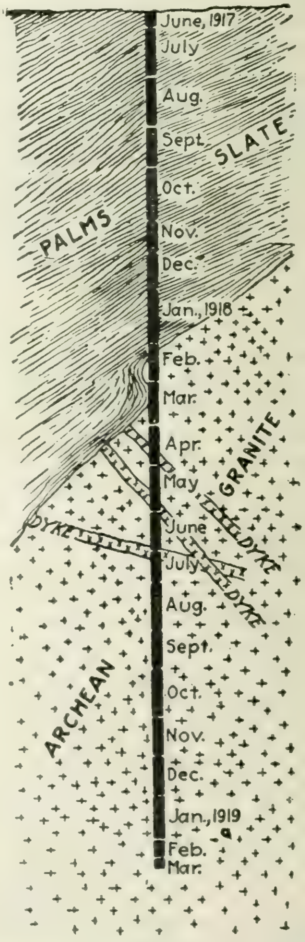
When material was removed from the shaft at the end of each drilling period the eight used drill machines were sent to the shop with the drill steel, and each machine was opened, inspected, cleaned, and lubricated before it was returned to the shaft. The result was an extremely low maintenance cost and a uniformly high drilling efficiency. The warehouse record shows a maintenance cost for the year 1918 to have been only $2.51 per month per machine. As each machine drilled 6,000 lineal ft. in hard ground, the cost of maintenance was $.005 per foot drilled. As convincing proof of the value of high-grade inspection and careful lubrication it may be stated that, upon completion of the shaft, the drills were mounted and placed in service on the main level drift and on sinking work at other mines.

As ⅞-in. hollow hexagon steel was in stock, this size was used in the sinkers, although they were designed to use 1-in. steel. The drill steel was made up with two-foot starters, and the last drill was eleven feet long. The bits were standard four-point with a 90° cutting edge and 5° and 14° taper. The gage of starters was 2 1-3 in., with ⅛-in. change in gage and 18-in. change in length. The steel was machine sharpened at the collar of the shaft in a No. 5 Leyner sharpener. No difficulty was encountered with steel breakage or inability to make the drills "follow."

Air for the machines was supplied by a 6-in. air pipe provided with a standard manifold. A specially designed header was discarded early in the work, as its use was found to be troublesome.

The cut was drilled so as to remove, when blasted, a "V" at the center of the shaft, and consisted of five rows of five holes in each half of the shaft, with three extra holes drilled straight down across the center of the shaft. An accompanying diagram shows a plan and section of the distribution of the holes.

In the diagram fifty-three holes are shown. In slates fifty holes were drilled, the three center holes marked *"B"* being omitted. The numbers on the holes refer to the order of blasting. The three holes marked *"B"* were shot by means of a battery to relieve the cut. The holes numbered 1 were fired first; 2, second, and the others in rotation, and the row numbered 1 was fired first;



3—SHOWING PROGRESS AND MATERIAL

4—SHAFT SINKING CREW

row 2, second, and succeeding rows in like order, the rows up to 6 being shot and then this part mucked out. Rows 7, 8, 9, and 10 were next fired in sequence, completing the cut. By firing in this order a wiggle, or staggered, effect was obtained, throwing the dirt from side to side, breaking any big blocks loosened, saving the shaft timber from damage, and putting the entire charge off as it was timed to go, without prematurely exploding other holes. Delayed fuses were used and the holes charged with eight sticks of 80 per cent Red Cross gelatine, the detonator being placed in the fourth stick from the bottom. This arrangement is contrary to the rule for placing the detonator, but owing to the fact that the holes are close together, the collar often breaks prematurely and tears out the detonators that have not been exploded. When this happens some of the holes do not explode and too much burden is placed on other holes.

No cut failed to be pulled clean, and not one steel shaft set was bent, although the sets were kept within fifteen to twenty feet of the bottom. The blasts were timed so close together that the effect was to blend the concussion in one slow, rattling blast.

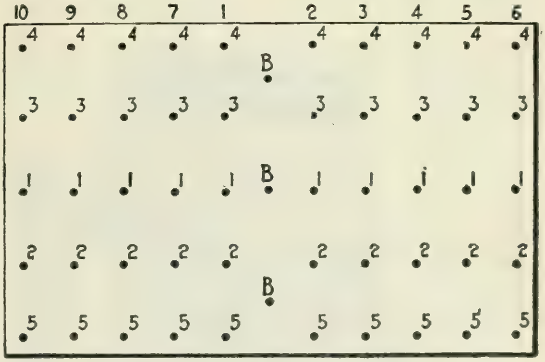
After blasting, the muck was hoisted in two 20-cu. ft. sinking buckets, provided with special guides. At the trestle landing the buckets were dumped while hanging straight on the cable, the rock falling on an inclined shaft cover. This sloping cover was hinged, provided with high sides that forced a chute, and was swung in and out of position by means of air-operated cylinders. The complete cycle of work in sinking was as follows:

TIME REQUIRED PER CYCLE OF WORK IN SINKING PABST "H" SHAFT

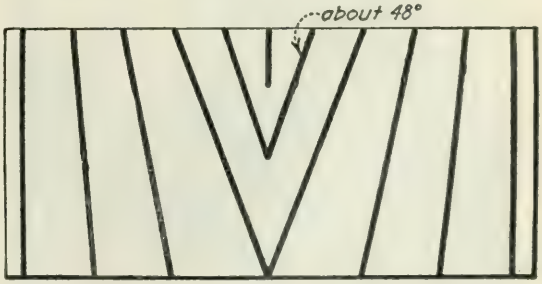
Operation	*Time, Hours*
Take down material and drill entire cut	6.0
Charge holes (first blast)	1.0
Remove material and blast	1.0
Blow smoke	1.5
Muck first blast	8.0
Charge second blast and fire	0.5
Blow smoke	1.5
Muck second blast	6.0
Hoisting water with bucket, per day	1.5
Timbering, per set	5.5
Cutting and blasting hitches	8.0
Installing bearers	3.0

The shaft sets extending through the encountered slates are made of 8-in., 34-lb., "H"-section steel and 6-in., 22.8-lb., "H"-section throughout the remainder of the shaft. They were spaced at 5-ft. centers. Dividers were of steel. Bearers were placed every 100 ft. in depth, four bearers to a set, one under each end plate and one under each cross divider. The bearers are 12-in., 31.5-lb. I-beams, 17 ft. long, cut in the middle for purpose of installing and spliced after being placed. Hitches 3½ ft. deep were cut to fit the steel, and this was done by drilling one side and the bottom of each hitch, the holes being placed side by side, each hitch requiring nine holes. Iron wedges secure the bearers.

The lath or lining consisted of pre-cast concrete slabs 8 in., 10 in., and 12 in. wide by 4 ft. 10 in. long and 3 in. thick in the slates and 2 in. thick in the granite. The slabs were designed with one vertical edge on each face, beveled to permit easy installation, and held in place by angles riveted to the "H" sections. The lath was wedged from the rear with cedar blocking. Men and material were handled on a cage, and dirt



Plan
(Drilling and Blasting)



Vertical Section

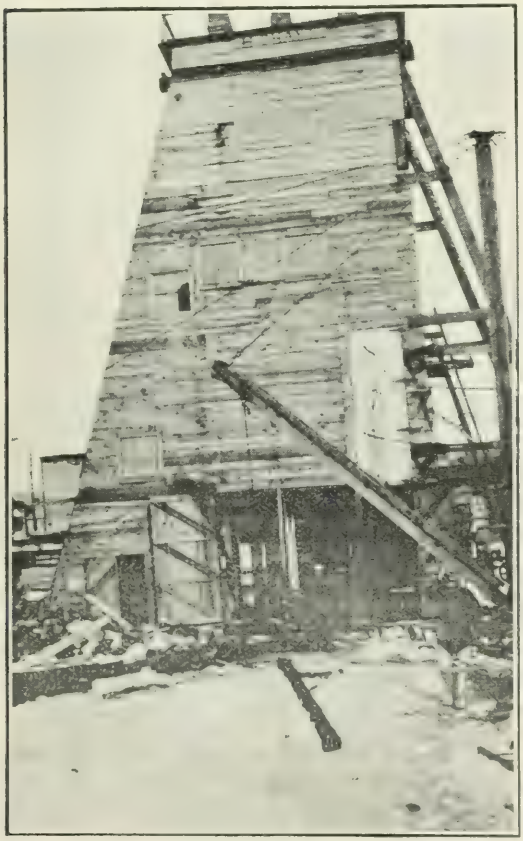
5—ORDER FOLLOWED IN BLASTING

6—HOISTING COMPARTMENTS, COLLAR OF SHAFT

was hoisted by buckets, the three hoisting compartments being used.

The equipment on surface was temporary, buildings and headframe as well as machinery. The machinery used was as follows:

Cage Hoist—One herringbone-geared drum, 48 in. x 36 in. Lake Shore Engine Works electric hoist driven by 112-hp. 440-v., slip-ring, General Electric induction motor.



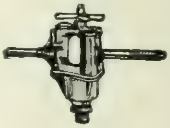
7—HEAD HOUSE OF SHAFT H

Rock Hoist—One of two drum, 48 in. x 36 in. herringbone-geared, Lake Shore Engine Works Electric hoist driven by 150-hp., 440-v., slip-ring, General Electric induction motor.

Surface Haulage—One Armstrong haulage plant, rawhide pinion and iron cut spur gear, geared to handle cars at 900 ft. per min., driven by 220-v., 50-hp., Westinghouse induction motor.

Air Compressors—Two 12-in. and 7½ in. x 12 in. Imperial, compound, short-belt drive, Ingersoll-Rand air compressors, each of 327 cu.ft. displacement at 210 r.p.m. and driven by 440-v., 50 hp., General Electric slip-ring, induction motors running at 1,200 r.p.m.; one 14 in. x 12 in. N. S. B. E., Chicago Pneumatic Tool Co. air compressor, of 487 cu.ft. capacity at 230 r.p.m., driven by 100 h.p. Burks, 220-v., slip-ring, induction motor running at 900 r.p.m., and one No. 5 Leyner drill sharpener.

The work of sinking this shaft was in charge of Gustaf Erickson, mining captain, and under the direction of A. G. Hedin, head mining captain. A. J. Wagner, writer of the above, was in charge of drills and responsible for their performance.



"In the end, the prosperity of a people always bears a true relation to their capacity for production. If the capacity for production be interfered with, as it always must be when workmen are discontented, because they feel that they unfairly share in the profits of industry and because of economic fallacies to which they cling that result in a conscious limitation of production, then the limits of national prosperity are sharply bounded, no matter what the richness of natural resources may be.

"Therefore I believe that the measure of our future prosperity in America is definitely related to the wisdom with which we work out the relationship between capital and labor. That relationship will never be wisely worked out in an atmosphere of economic ignorance. There is quite as much of that ignorance in the managing offices as there is in the factories."—Frank A. Vanderlip in "What Happened to Europe."

A War Adventure of the Air

NOTE—*The author of "High Adventure" told in a recent issue of U. S. Air Service the thrilling tale that follows, of a fight in which an anti-aircraft shell lodged between the cylinders of his rotary engine—but failed to explode. Capt. Hall served in the British Army fifteen months, and with the celebrated Lafayette Escadrille from June, 1917, to February, 1918. He had a most exciting career as a fighting pilot in the war. He was wounded and brought down in No Man's Land, June 26, 1917; resumed active service, Sept. 15, 1917; was transferred to U. S. Air Service, February, 1918; wounded, brought down and captured, May 7, 1918. Omissions from his article are indicated by asterisks.*—THE EDITORS.

By *JAMES NORMAN HALL*

EDDIE RICKENBACKER, Eddie Green, and myself—all pilots of the 94th Pursuit Squadron, U. S. A.—were on *alerte* duty at our aerodrome at Toul. It would be impossible to forget that fine Spring morning—May 7, 1918, to be exact—when, as the result of a combat and a series of bizarre accidents which happen only in the air, I found my plane tumbling completely out of control at a point about five kilometers back of the enemy's lines. We took the air in response to a telephone call from an infantry observation post. An enemy formation was reported approaching our lines in the vicinity of Pont-a-Mousson. After a twenty-minutes search we sighted it, five Albatross single-seaters, north and west of that town.

At that period the 94th was equipped with a new and untried plane, the new Nieuport, type 28, single-seater, rotary motor, lower wing ailerons, a machine built by the French Nieuport Company. It was a splendid little craft—for pleasure purposes. It climbed rapidly, manoeuvred well, and was better than the Spad for acrobacy. But it had been rejected by the French Government as being not strong enough to weather the tremendous strain to which fighting planes are subject in combat.

The United States Air Service had been compelled to accept them as plane equipment for the 94th, but newly arrived at the front, for the French were not then able to live up to their agreement to furnish American pursuit squadrons with Spads, their best type of combat machine. All of which explains the "series of bizarre accidents;" for had we been flying trusty old Spads I should not have had to cool my heels in a *kriegsgefangenen lager,* "ground-flying," after the fashion of aviator prisoners of war.

The combat started at 14,000 feet. Having the advantage of the enemy in altitude, we attacked immediately, they being compelled to dive further into their own lines because of their inferior position. While diving vertically upon the enemy nearest me, the fabric covering the upper surface of my upper right plane burst along the leading edge, throwing the plane completely out of balance. Compelled to leave the combat immediately, I turned toward our lines, which could be seen in the distance, but oh! so unalterably in the distance.

The wide rent in the fabric of the wing increased in size under the steady encouragement of the wind. Other strips ripped loose and flapped and fluttered out behind. Enemy anti-air-craft fire was brisk and increasingly accurate during that precarious journey homeward. Owing to the damaged wing I was unable to manoeuvre.

It was a moment of intense excitement. All airmen have known similar ones when their hopes of safety hung in a balance jauntily swaying back and forth, with old Godfather Chance jiggling the scales in a purely vindictive mood. Looking behind and below me I saw my former quarry become huntsman, climbing toward my level for all he was worth. Occasionally he would pull up and fire a burst in my direction. Then he would lose speed, fall off on a wing, nose down to gather speed and repeat the manoeuvre. But he was yet too far distant and too far below me to make accurate practice, and I knew that I was in no great danger from him till he could climb to my level.

The bark of the Archies was really ominous. When those dogs are on the scent, and one's old bus is worn out and incapable of swift flight, how vicious they seem, and how they snap at one's heels!

Suddenly I felt my plane give a violent lurch. The motor spilled forward, wrenched partly loose from its bed, and down we went, plane and pilot, toward that inhospitable land bounded by German trenches. It was not until afterward that I learned the reason for the sudden descent. A small incendiary shell from a quick-firing gun had struck my engine. It stuck there, and failed to explode, but ended for all time the delicate functioning of that marvelous little Rhone motor.

I wondered in that peculiarly objective way which is the most amazing thing to reflect upon afterward, what the result of this adventure was to be. I believed at the moment that I didn't much care, for I had read many stories of the treatment by the enemy of allied prisoners of war. Death seemed a preferable fate.

The suspense was not long drawn out. Aerial troubles bring intense anxiety, but they have the merit of passing almost with the swiftness of thought. I remember the elemental roughness of Mother Earth's welcoming embrace, a shock of pain in legs and head, and then, despite my fear of German prison camps, the great surge of joy at the consciousness of being alive. After all, life is sweet, and a few moments of illuminating experience taught me how much more truthful one's instincts are than professed beliefs.

I thought that I wanted to be killed, but nature knows what is good for us and doesn't take any stock in our melodramatics. At any rate, she very effectively overruled my impulse, if I really had one, to let matters take their course. She merely gave me a fleeting but vivid glimpse of a green field spinning up to meet me. And I gave a violent pull on my control stick in an effort to save myself from a too-hasty contact. The result was that I did not crash hopelessly, and now have behind me an experience which is, in a melancholy way, some compensation for the loss of freedom.

Seeing German soldiers rushing from all sides toward my machine, I expected rough usage, and scowled in what I thought must be true Hauptmann fashion, hoping to overawe them. This was a needless effort. One of the first men to reach me said: "You are hurt, Sir-r-r?" in good German English. I told him that I was, a little, whereupon he immediately called two others. They lifted me gently out of my seat, and carried me to a dugout at the edge of the wood. * * *

A good many soldiers followed me down into the dugout. I felt uneasy when I saw no officers among them, thinking: "This is where I lose my few possessions, and Lord knows when I'll get a new outfit of clothing." However, although they could have taken everything from me in the absence of their officers, and no one any the wiser, no attempt was made to do it. Instead of that, an elderly German orderly brought me a cup of hot coffee from a compact little kitchen adjoining the messroom. * * *

An ambulance man came, and in a jiffy he had my right leg in splints and carefully bandaged, and my head bound up, (both ankles and my nose had been broken in the fall, the right ankle rather badly.) Then I was given a German cigarette and began to think: "This is not going to be so bad as I expected." The soldiers cleared out in a hurry upon the arrival of an officer. He saluted with a stiff little bow from the hips, as Germans always do, told me in English that he was sorry, but "fortunes of war," and so on. Then he asked if I would let him see my papers. Luckily I had nothing but 800 francs in money—it was the first of the month—and my identification card. At least I thought I had nothing else, although later I found a typewritten sheet of squadron orders in my trousers pocket. In a moment of unguarded leisure I chewed this up and swallowed it, my stomach receiving the morsel not gladly, but in a spirit of admirable resignation. The officer kept the card, returning my pocketbook and money, accepting my word for it that I had nothing else.

About half an hour after this several other officers, aviators, arrived. Each of them saluted and bowed in the same smart, soldierly, but rather odd way. Then one of them said that they had had the honor—a nice way to put it, I thought—of fighting with my patrol that morning, and that my two comrades had returned safely. Without any apparent bitterness, he added that, as a result of the combat, a pilot of their squadron had fallen in flames and was burned to death. (This machine was brought down by Eddie Rickenbacker, needless to say, a fine *chasse* pilot.) He inquired about my injuries, and told me that the nearest hospital was at some distance. If I could endure the delay they would be glad to have me lunch with them at their squadron headquarters which was not far out of the way. I accepted with a good deal of reluctance, not feeling in a company mood, but brightened at the thought of what had just been happening. This might have been a conversation among friends in front of the Café de la Paix in Paris.

As they carried me to their car, I felt more like a pampered Back Bay baby going for an airing in the Boston Public Gardens than a prisoner of war. They left me in the car at the side of the road, while they went over to have a look at my wrecked machine. This gave me a moment for collecting my thoughts.

I had often been warned that a prisoner must be very much on his guard. I had heard that a favorite German ruse with a captured aviator was to take him to a squadron mess, wine and dine him, particularly the first, so that he might forget his caution. Then when he was sufficiently mellow, they pumped him dry of information and sent him on his way, feeling well repaid for their liberal expenditure of good Rhine wine.

Sometime, so I had been told, they tried browbeating a good deal depending upon their estimate of the captive. I hoped that this latter would be the method chosen with me. It is hard to be suspicious of courteous and hospitable treatment; but one can easily meet an attack which is a straightforward attempt at "bulldozing." I knew, of course, that prisoners have their rights and cannot be forced to talk.

I had a homesick moment while sitting there, waiting for them, thinking of the uncertain future, aware that for me even an attempt at escape was out of the question for months to come. Far in the distance I heard the faint drone of rotary motors, a sound high-pitched, familiar, terribly saddening under those circumstances. It could come, I knew, from the craft of only one squadron, the 94th.

Soon I saw them, flying very high, almost directly overhead, the motors humming drowsily. They were moving unconcernedly on, tipping up now and then in a steep bank, making jaunty earth-scrutinizing changes of direction which told me that they were perhaps searching for some trace of me.

I wanted to shout, to wave my hand, to pull myself by my boot tops away from the solid earth. If only I could have reached up far enough to tighten my fingers around a tail skid, I felt that I could hang on long enough to be carried across that little strip of enemy ground. Then I could have dropped into the Moselle where it flows through friendly territory. But they were miles above me, and so I sat there watching them, helpless and sick at heart. * * *

It was a ride of about fifteen kilometers to the aerodrome of the German squadron. I learned that these officers belonged to a combat group lying directly opposite our own sector of the front. Mars-le-Tour, the town near which they were stationed, had been a place of considerable interest to us. * * *

Evidently they were equally curious. Had it not been wartime, and had I been in a more comfortable frame of mind, we might have had a most interesting chat, comparing notes as to time and place of combats. Some of them spoke French and others English, so that there was no difficulty in conversing. But I had to keep clear of the subject, lest I should disclose, even approximately, the location of our squadron. My German hosts, or captors—I hardly knew in which light to consider them then—respected the difficulty of my position and asked no embarrassing questions. I could, however, talk quite freely with my opponent of the combat, an experience somewhat unique for two enemy airmen. We chatted informally and pleasantly of our encounter and compared notes as to our feeling at the times when we were pursuer and pursued. * * *

While we were waiting for lunch one of the men sat down to the piano and played some French music, songs which I had heard in our own mess only a day or two before. For a moment I was tempted to let my preconceived notions of the Germans go to the deuce, and talk as one human being likes to talk to another. I wanted to let down the barrier of reserve, as they seemed ready to do. Then came the suspicion: "This is doubtless a part of the game. First the mellowing influence of music, then that of wine, and then the indiscreet disclosures." These ever-ready suspicions may see a trifle ridiculous; but it is far better that a prisoner of war be too cautious than not cautious enough. Furthermore, American aviators were rareties on the German side of the lines at that time, and I knew that the enemy were mighty curious about the plans and the organization of our air force.

Well, the wine proved to be *café au lait!* First we had a roast, then a salad, dessert, and the coffee to wind up with. No wine, no liquors of any sort. * * *

Everything was open and above board in so far as I could judge. None of the officers felt it his duty to act as a self-appointed intelligence officer. I was even informed beforehand that one acting in that capacity was coming soon to see me, so that I was ready for him when he did appear.

He was a man of about 45, erect, soldierly looking, with a pleasant face, not at all the Prussian type of official I had expected to see.

He greeted me in a jovial sort of way with: "Well, Hall, tell us all about it. What are you people doing over there?"

I thought to myself "Watch your step! That hearty, last-name sort of greeting does very well in America, but it isn't a German practice."

However, it certainly seemed natural enough, and I decided that I could meet apparent friendliness with apparent friendliness without damaging the allied cause greatly. So I said:

"All right, Major; you know how we Americans love to brag. Ask me whatever you want to know."

He began by asking me what my belief was about the treatment I should receive at the hands of my captors.

"Now, tell me frankly," he said, "haven't you expected that your ears would be cut off, or your tongue slit—something of that kind?"

I said that I had heard some pretty damning things relative to the German treatment of prisoners of war, but I knew that there were good Germans as well as bad ones, and was relieved (subtle flattery) to find that I had fallen into the hands of the decent ones.

* * * It was now my turn to answer or to refuse to answer questions. However, I was first told by this officer what he knew, or thought he knew, of the movements of our troops and the organization of our air force; what squadrons were on the front, what others were soon to be there, and so on. He told me also of the movements of British and French squadrons, and showed me photographs of allied aerodromes along the Meuse and Toul sectors. * * *

He told me that he knew exactly where my squadron was located and how long it had been there; but evidently he did not, for he was anxious that I should either confirm or deny his statements. Finally, weary of persistent questioning, I said:

"I tell you what I'll do, Major. I will leave the matter to these officers. Supposing one of them to be in my position as a prisoner, questioned by one of our intelligence officers. If any one of them will honestly say that, under such conditions, he would be willing to give the location of his squadron headquarters, I'll tell you where mine is."

Although I would have found a way out of it, it would have been awkward not to have fulfilled this promise had there been occasion for doing so. But those pilots were gentlemen. All of them said that in my place they would do as I was doing.

The Major was a decent old fellow, and didn't question me any further. On several after occasions he sent greetings on to me by other American aviators who passed through his hands.

After the examination, my airmen hosts—they had proved to be hosts after all—ordered their car, and the Major and an officer from group headquarters went with me to the war hospital at Jarny, not far from Metz. * * *

I must not forget to speak of another courtesy extended me by the pilots of this German squadron which, I believe, cost the pilot who did it his own freedom. It is a practice among airmen at the front, in case of the capture of an enemy pilot, to drop a message giving this information on his own side of the lines. I had asked if this might be done for me, adding, for caution's sake, that they might throw it out somewhere between Verdun and the Vosges Mountain. They replied that they would willingly deliver such a message, and they did.

Some Americans from my own group, captured later, told me that the note was dropped and received, and that the German pilot who carried the message was shot down in our own lines by an allied airman who knew nothing of his mission. Since returning to France I have heard from other members of my group that the German airman who dropped the message was shot down and made a prisoner two or three days after he had delivered it. Major David Peterson, the man best able to give me the facts of the incident, has since been killed in an airplane accident, and I have not been able to get the exact truth of it.

On the way to the hospital I discovered that I had left my flying helmet and gloves in the dugout near the field where I fell. I spoke of this in some by-the-way fashion. I think I said that the helmet had a sentimental value which made me sorry to lose it. Two or three days later one of the pilots came to the hospital to see me, bringing both gloves and helmet. Not only that. He also brought two snapshots which he had taken on the morning I was shot down, one of my wrecked machane and one of myself, sitting in a motor car belonging to their squadron, souvenirs which are precious to me.

One glance at them carries me in a moment over the months and the miles to Pagny-sur-Moselle, and recalls vividly my last adventures in the war. To get these he had to make a journey of about thirty-five kilometers. On several occasions the German pilots from Mars-le-Tour flew very low past my window at the hospital, waving to me as they went out or returned from patrol. They were sportsmen and gentlemen, and I should be glad to meet them again.

So much for my early treatment at the hands of the Germans. There followed six months of captivity, first at the German war hospitals at Jarny, in occupied French territory, and at Saarbrücken, Rhineland; then in the prison camps at Rastatt and Karlsruhe, Baden, and at Landshut, Bavaria. The rest of the story may be told briefly in the words of a fellow-aviator, likewise a *kriegs-gefangener*: "Wonderful people, wonderful country, and, oh! such exquisite soup!"

AIR MACHINERY EXPORTS

The Division of Statistics of the Bureau of Foreign and Domestic Commerce, Department of Commerce, furnishes the following figures on United States exports of air compressing machinery for the month of August, 1919:

Counties	*Dollars*
Denmark	65
France	89.833
Italy	18.089
Norway	7.040
Spain	11,872
England	25.803
Canada	22,965
Guatemala	33
Honduras	24
Salvador	163
Mexico	24,580
Newfoundland and Labrador	1
Trinidad and Tobago	1,067
Cuba	3,121
Dominican Republic	168
Argentina	2,510
Brazil	14,613
Chile	10,854
Peru	138
China	1.550
British India	5.369
Straits Settlements	5,700
Dutch East Indies	1,668
French East Indies	105
Japan	1.532
Australia	38,302
New Zealand	169
Philippine Islands	78
British South Africa	503
Total	$287,915

Development of the Rock Drill in America—Past and Present

By CHARLES AUSTIN HIRSCHBERG

NOTE.—*The subjoined article, narrating the history of the development of the rock drill in America, and which is one of the most comprehensive and authoritative treatises on the subject ever published, was prepared by Mr. Hirschberg of "Compressed Air Magazine" staff for the columns of our valued neighbor, "The Engineering and Mining Journal," through the courtesy of which periodical we are also able to publish it. The author might have carried this history a step further and shown how the rock drill is the real progenitor of many other pneumatic devices; for instance, the riveting gun and the chipping hammer, which latter are not original inventions, but are off-shoots of the same family.*—THE EDITORS.

COLORADO, known to many as the land of scenic beauty and mountain grandeur, is not only the playground of the tourist and the mecca for the followers of Isaak Walton, but is also the school of the inventor, brought about perhaps by the great industry of mining for gold, silver, platinum, radium, zinc, lead and many other minerals employed by man in the useful arts.

FIG. 1. THE PROSPECTOR OF '49.

What better incentive could man want to spur him on to the ultimate goal of success than the knowledge of its vast stores of wealth, and its sunshine, glowing from the heavens upon him like a benediction throughout 365 days of the year.

FIG. 2. PRIMITIVE ROCK DRILLING.

Cunning nature, running true to form, hid her treasures deep amid the hills, so that man must seek and toil to realize his desires, and so, from green valley to timber line and over the snow capped range we find tawny men beating trails to Colorado's treasure store in the fifties of the past century, bringing with them the pick and the shovel and the single jack and steel. This was the start of the gold fever in the State of Colorado.

Event succeeded event rapidly until 1879 when a new period set in with the discovery of the lead-carbonate silver ores of Leadville. It was about this time that man put aside his single jack and steel in favor of the power rock drill, invented by J. J. Couch of Philadelphia in 1849 and perfected during the intervening years by Couch and J. W. Fowle of Boston, patent rights finally being purchased by Chas. Burleigh about 1866. The Burleigh drill was used in driving the Hoosac Tunnel in the year 1867.

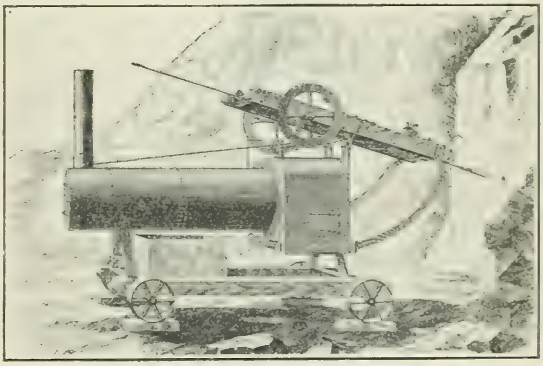


FIG. 3. THE COUCH ROCK DRILL—THE FIRST POWER ROCK DRILL.

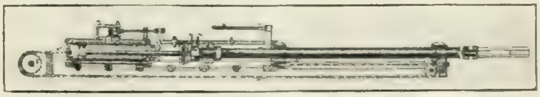


FIG. 4—FOWLE'S FIRST ROCK DRILL.

In 1871 another power rock drill was invented by Simon Ingersoll, and still other similar drills, such as that of Wood, Sergeant, Waring, Halsey and Githens, made their appearance. From this time on, man's primitive hand methods of mining faded rapidly, giving way to the so-called reciprocating piston rock drill, which comprised a cylinder carrying a piston with a projecting end, to which was rigidly fastened a drill steel.

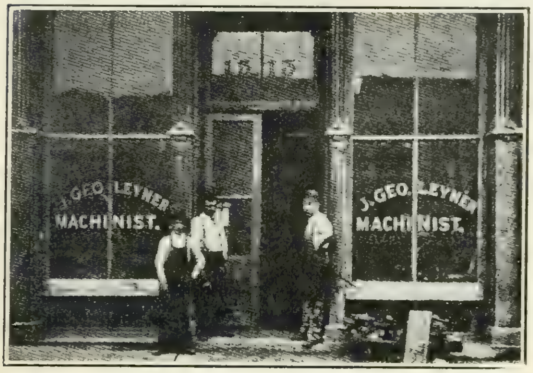


FIG. 5. J. GEORGE LEYNER'S FIRST MACHINE SHOP IN THE OLD BUSINESS SECTION OF DENVER. MR. LEYNER IS THE CENTER FIGURE IN THE DOORWAY. THIS PHOTOGRAPH WAS MADE IN THE EARLY NINETIES.

The year 1894 inaugurated another new period in the history of the State of Colorado, with silver mining predominant. It was about this date that J. George Leyner, a native of Colorado, born in Boulder County, opened the shop shown in Figure 5, in the City of Denver, for the repair of mining machinery. This enterprise led him into numerous experiments with the power rock drill, finally culminating in the invention of the first hammer drill about 1897, a type in which the piston moves freely in the cylinder and strikes upon the drill steel instead of being attached fixedly to it, and pushing it as in the reciprocating type of drill, a direct reversion to the principle involved in the primitive method of single jack and steel.

There is no questioning the debt which the mining industry owes to the invention of the reciprocating type of rock drill, but it remained for a Western man, Mr. Leyner, born and raised amidst the hustle and bustle of the mining camps of Colorado to take a real scientific step forward in the art of drilling rock. No need to dilate at length upon the things he accomplished in the invention and development of the hammer drill—the introduction of water and air through hollow drill steel for cleaning the hole, automatic lubrication, enclosed-in-the-machine throttle control, mechanical rifle-bar-rotating drill steel chuck—in fact all hammer drills of the present day, irrespective of maker, have borrowed their most important features from the Leyner Hammer Drill.

In testimony of the value and correctness of his theories, his business grew to a point where in 1905 he was forced to build a modern manufacturing plant at Littleton, Colo., to take care of a rapidly growing enterprise, finally ending in the purchase of license rights by the Ingersoll-Rand Co. of New York, since which time many modifications and refinements have been made, as typified in the Leyner-Ingersoll Drill.

Still another product of Colorado's inventive genius is the creation of the Stoper Drill, which depends for its success upon an air feed attachment to a drill cylinder, first experimented with by C. H. Shaw of the C. H. Shaw Pneumatic Tool Co., Denver, Colo., about 1906, followed rapidly by the Waugh Slugger, also an air feed type of machine, then the Crown Air Feed Drill of the Ingersoll-Rand, the Hardscog Wonder Rock Drill, the Sullivan, the Cleveland, the Leyner Stoper and the Chicago.

These inventions proved the progenitors of other styles of hammer drills, in fact the latter may be termed modifications of design of these first types. For instance, the majority of the early hand hammer drills (excepting plug drills, employed for drilling shallow holes in granite and stone) were largely patterned after the air feed

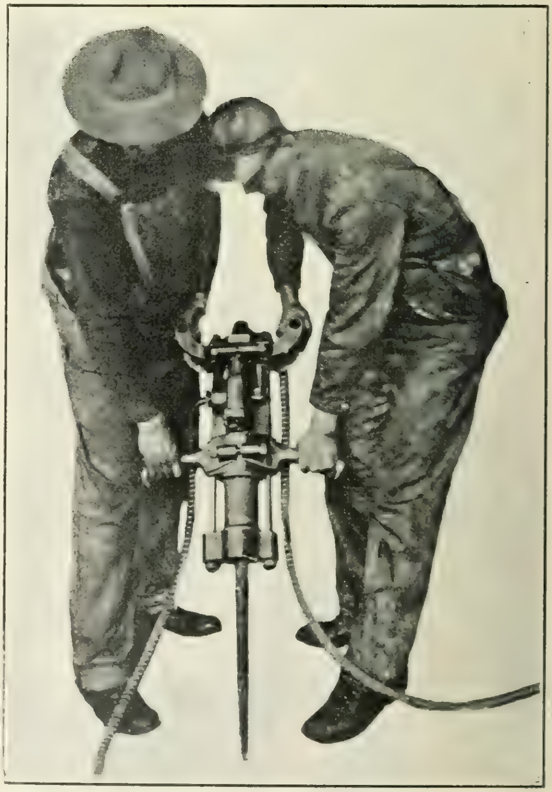


FIG. 6. THE FIRST SELF-ROTATING HAND HAMMER DRILL.

stoper, the air feed being eliminated and a spade handle substituted, in fact the manufacturers of these early stopers advertised the interchangeability of handle and air feed as a feature.

This early practice of interchangeability was, however, soon abandoned, for while good in theory it proved impracticable, and we then find the appearance of the Little Jap Drill, an Ingersoll-Rand product, followed rapidly by such machines as the Sullivan Hand Hammer Drill, the Hardscog Little Wonder, Cleveland Hand Drill, Leyner Brownie and numerous others.

In the year 1909 the first real self-rotated hand hammer made its appearance. Following the practice of making hand drills out of stopers, Mr. Leyner conducted extensive experiments with a Leyner drill cylinder removed from its shell. As will be seen from the illustration, Figure 6, he placed a T handle at the back with additional handles part way down the cylinder. He built several of these machines, more particularly for shaft sinking. However, before he had gone very far the Ingersoll-Rand Co. obtained a license to manufacture and sell under the Leyner patents, and as early as 1912 the Jackhamer, the first self-rotating hand hammer drill employing Leyner rifle bar and sleeve chuck rotation, was placed on the market. It proved such a success that other manufacturers brought out modified designs.

We often hear it said that there is nothing new under the sun. To some extent this saying may be applied to present day drill designs. Things which had been tried and tested in the early struggle with reciprocating drills, and later with the first Leyner Drills, but abandoned because of their failure to perform as expected, and again in the latter case, because of the impossibility of securing suitable materials and a lack of knowledge in those days of refined methods of heat treating to enable materials to stand up under the particular work they were to perform, are today making their appearance in the designs of many drills, and are exploited as "new."

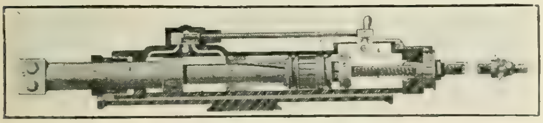


FIG. 7. THE BURLEIGH ROCK DRILL.

Referring to Figure 7, this shows the first reciprocating rock drill, as used by Burleigh in driving the Hoosac Tunnel in 1867, a project of construction fathered by the State of Massachusetts. The tunnel was 5 miles long driven through hard rock. It was an ambitious scheme for those days, involving at its start the employment of hand drilling. That the work in driving this tunnel was carried to a successful conclusion was largely due to the efforts of J. W. Fowle of Boston, who invented the Burleigh Rock Drill. Burleigh's part in the development of this early rock drill rested with certain improvements which he made as a mechanic in the shops of the Fitchburg Machine Works, where the machine was built.

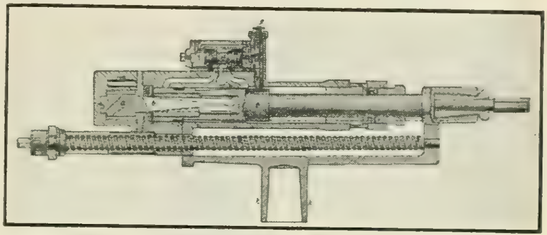


FIG. 8. THE FIRST WOOD DRILL.

The Wood Drill shown in Figure 8 was brought out shortly after the Burleigh Drill had made its appearance on the Hoosac Tunnel. In the testimony before the Massachusetts Legislature appears the following statement—"We were satisfied that this drill was an entire infringement on Mr. Burleigh's patents, and that our obligations to Mr. Burleigh ought not allow us to suffer the Michigan Drill (Wood) to be used by our contractors."

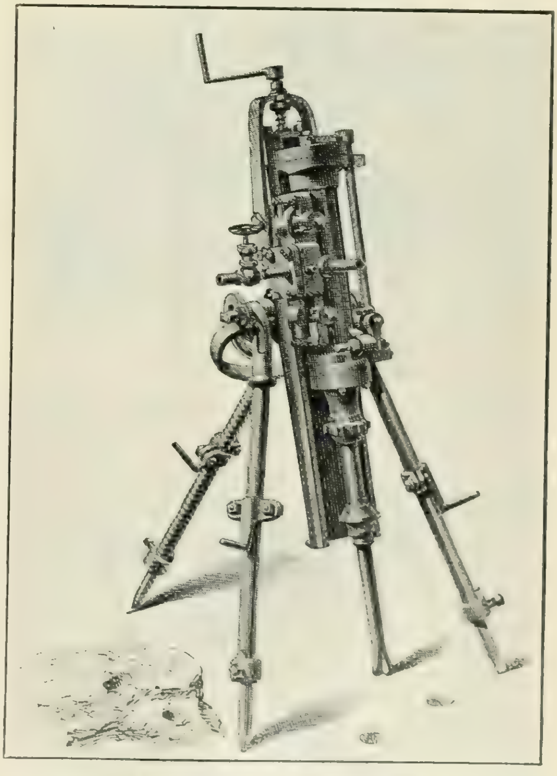


FIG. 9. THE INGERSOLL DRILL.

The Ingersoll Drill as shown in Figure 9, which employed a tappet valve action and followed somewhat new lines of design in that it utilized a guide shell with feed screw for feeding the machine forward, making it very much lighter and, therefore, possible to mount on a so-called bar mounting in place of a carriage mounting, came next. It was employed in the Musconetcong Tunnel of the Lehigh Valley Railroad. This was about the year 1871.

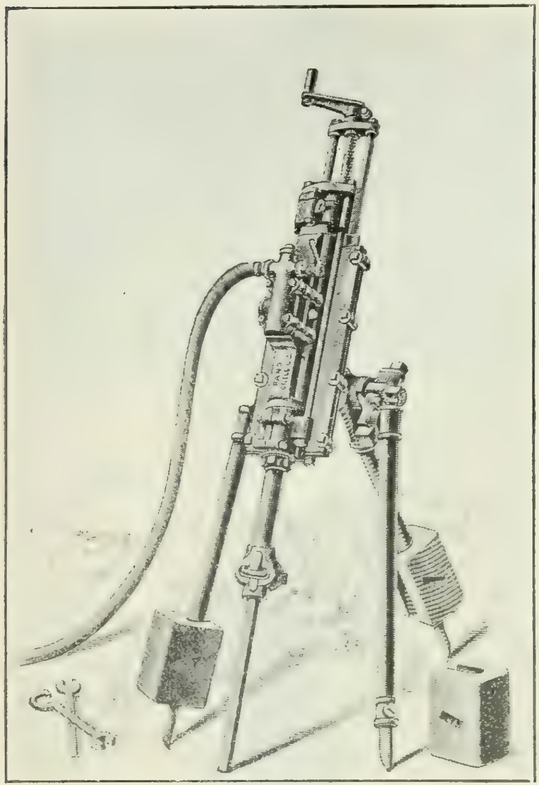


FIG. 10. THE RAND LITTLE GIANT.

Figure 10 shows the Rand Little Giant Drill as developed by A. C. Rand and George Githens in 1875. This drill also employed a tappet action controlled by the motion of the piston to operate a flat slide valve, as shown by the cross-sectional view Figure 11. It was with this type of machine that the side rod construction made its appearance, which is found even today in later drills, such as the present day Leyner-Ingersoll, the Sullivan Water Drill, the Sullivan Piston Drill, the Denver Dreadnaught and many others. See Figure12.

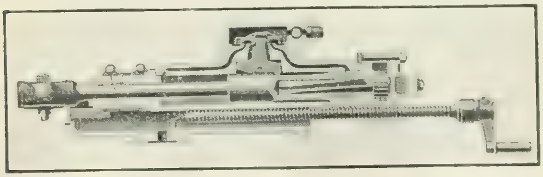


FIG. 11. CROSS SECTION OF THE RAND LITTLE GIANT

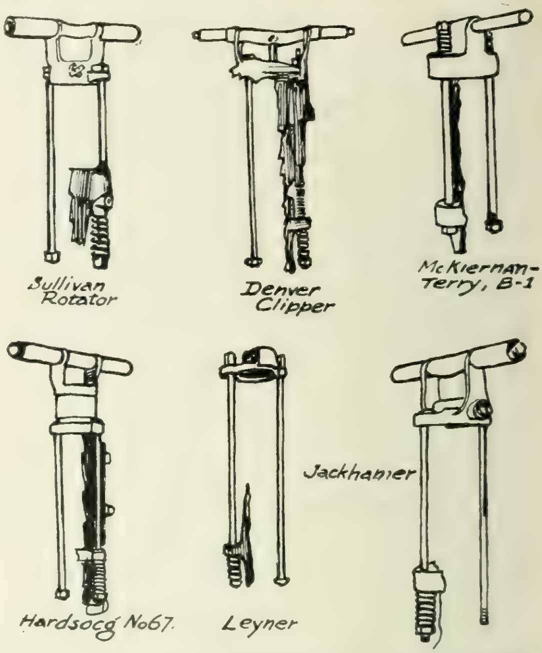


FIG. 12. SIDE ROD CONSTRUCTION OF MODERN DRILLS.

The Rand Little Giant Drill was largely adopted throughout the Lake Superior iron country as well as certain sections of the copper country. Some of its notable work is the Hell Gate Channel excavation and the Weehawken Tunnels.

Figure 13 shows the Ingersoll Eclipse Air Thrown Valve Drill, which was an improvement over the Ingersoll Drill invented by Henry C. Sergeant 1873 and brought to its final state of development in 1878. This was the first independent valve motion control. The Ingersoll Eclipse Drill was employed in driving such tunnels as the Cascade, Bozeman, Silverbow, Siskiyou, Snow Shoe, Vosburg, Coosa Mountain, Wickes and Croton Aqueduct.

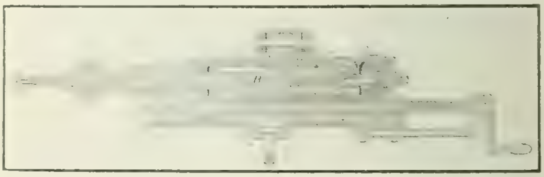


FIG. 13. INGERSOLL ECLIPSE DRILL WITH AIR THROWN VALVE.

Figure 14 shows the Slugger Rock Drill invented by Halsey and introduced by the Rand

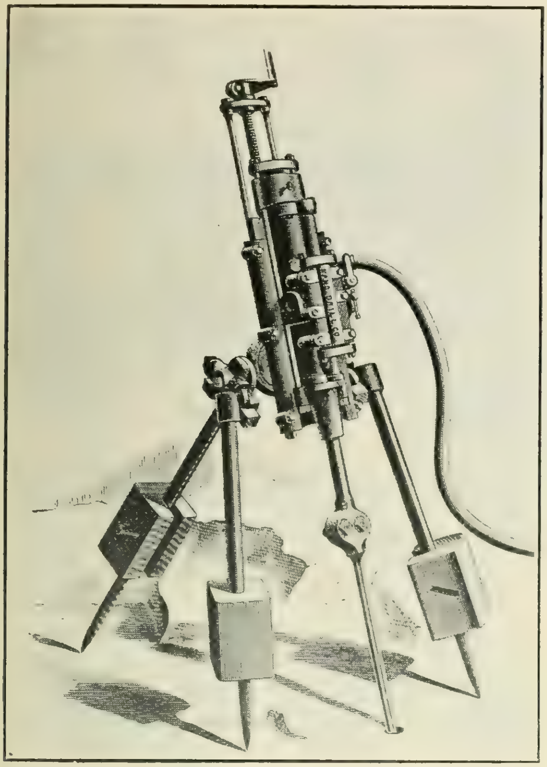


FIG. 14. THE RAND SLUGGER ROCK DRILL.

Drill Co., now the Ingersoll-Rand Company, in 1883.

This machine, it will be noted, is equipped with side rods and a flat back head spring to absorb shocks. The valve is of the piston or spool type. While having an independent valve action it was without variable stroke. It was largely used in mine work and in some of the big aqueduct tunnels.

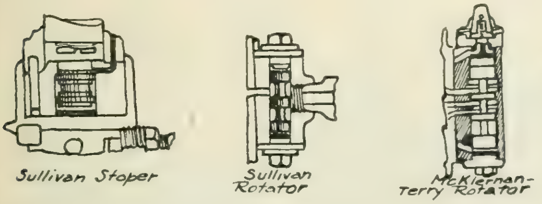


FIG. 15. MODERN VALVE ACTIONS OF THE PISTON OR SPOOL TYPE.

A great many of our modern day drills employ independent air thrown valve actions patterned largely after these two first types. Even the first Leyner Hammer Drill borrowed the spool valve from these early constructions. Figure 15 shows the valve action of a number of various makers' drills of today which fall under the same classification.

In 1884 the Sergeant Auxiliary Valve Drill came to the front, bringing with it the release rotation and a spool valve motion controlled by a crescent shaped piece in contact with the main piston, as shown in Figure 16.

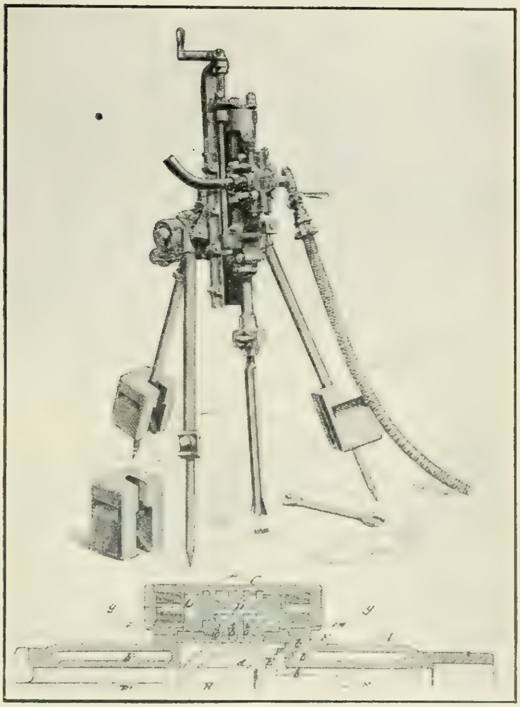


FIG. 16. THE SERGEANT ROCK DRILL.

This type of drill largely replaced the Little Giant in the Lake Superior mines and drove the Catskill Aqueduct Tunnels and many others, among them the Pennsylvania Tunnel under the East River, New York.

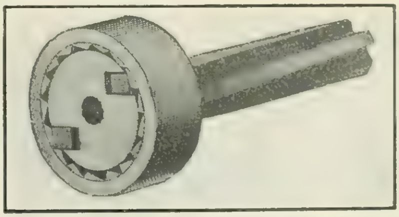


FIG. 17. SERGEANT RELEASE ROTATION.

The release rotation feature of this type of drill shown in Figure 17, gradually found its way into other makes of drills including the No. 6 Water Leyner Drill brought out by Leyner in 1908.

Starting about 1898 up to the present time we pass through a revolution in the mechanics of the rock drill. This is the period of hammer drills

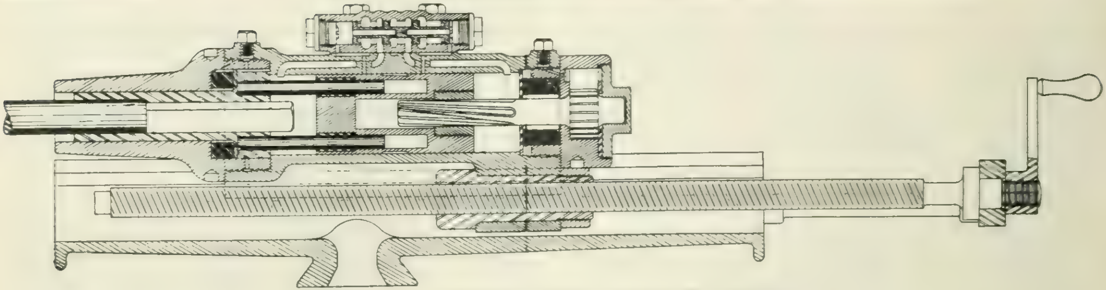


FIG. 18. LEYNER'S FIRST HAMMER DRILL.

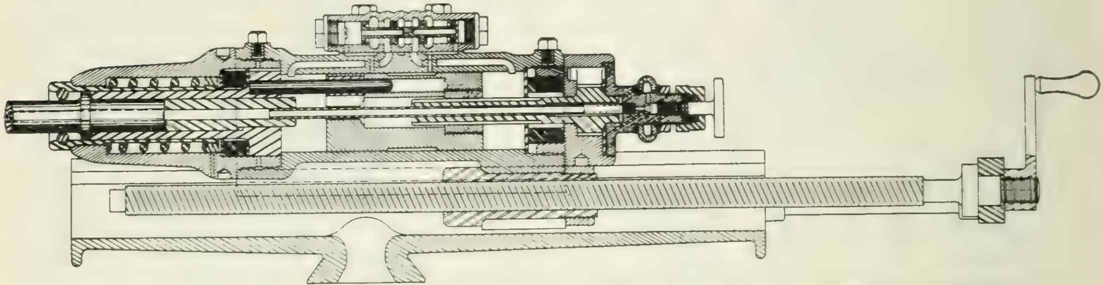


FIG. 19. LEYNER DRILL—THE FIRST HAMMER DRILL WITH THE WATER FEATURE.

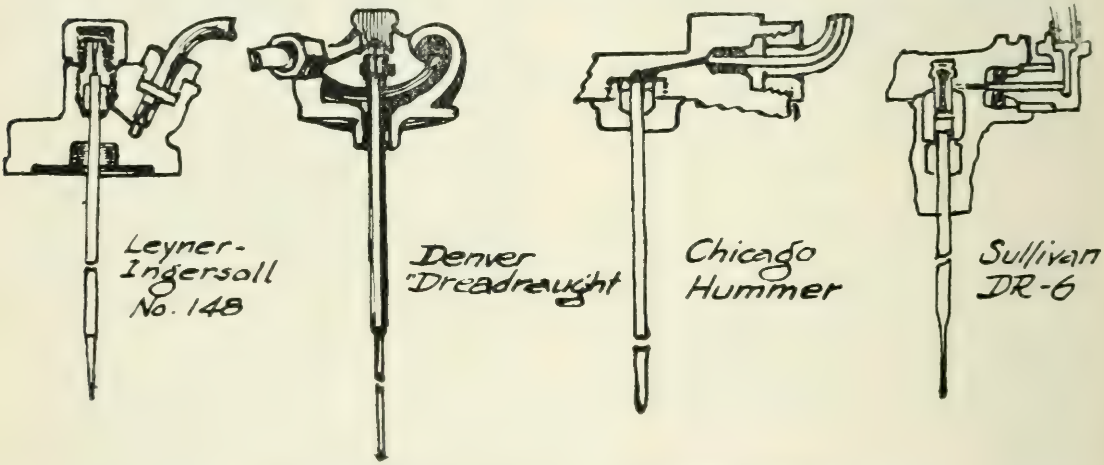


FIG. 20. WATER FEATURES OF MODERN DRILLS.

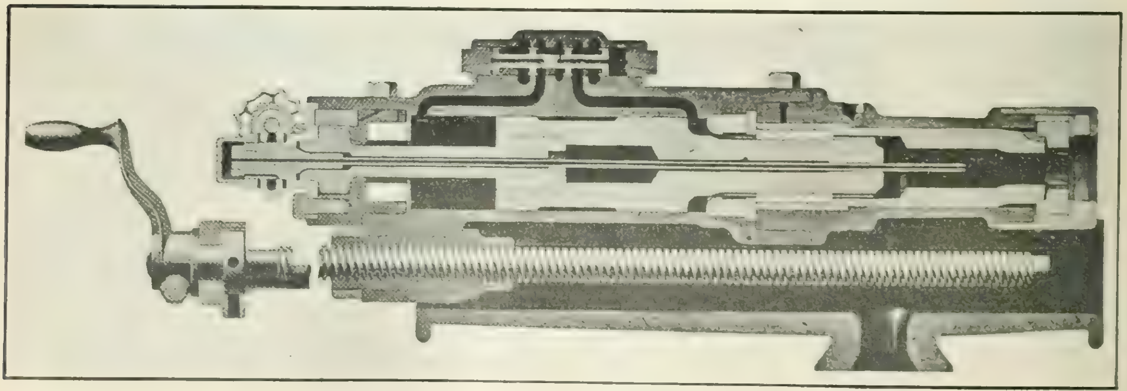


FIG. 21. No. 5 WATER LEYNER DRILL.

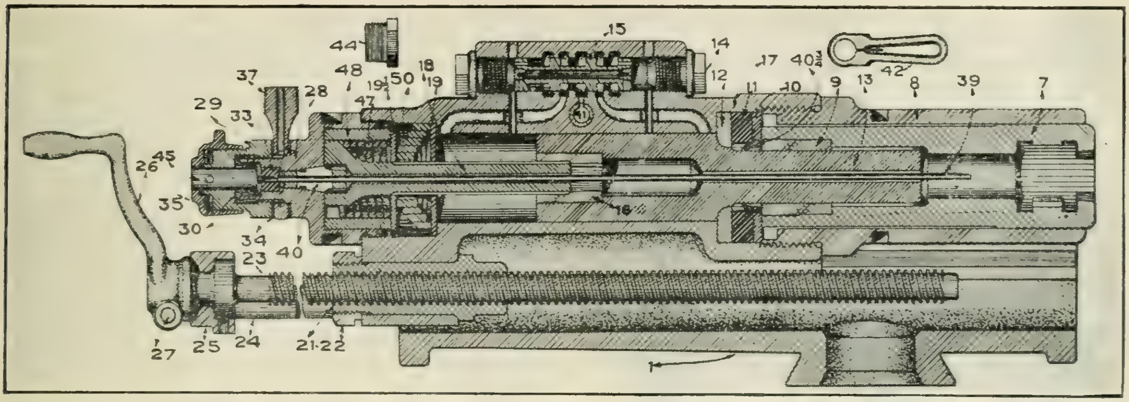


FIG. 22. CROSS SECTION OF MODEL 6. WATER LEYNER DRILL.

and we see the gradual passing of the piston drill. Leyner's drill as shown in Figure 18 made its appearance in 1897, followed by the type of drill shown in Figure 19, in 1898, it being the first of his or any other drill to employ water and air through the drill steel.

Referring to Figure 20 we find present day builders of hammer drills borrowing in its essential details the water and air principle of the Leyner Drill. Figure 21 illustrates the No. 5 Leyner Drill brought out about 1903, showing substantially the same type of rotation first employed in the later models of Leyner Drills, excepting that it had a locking key for holding the steel in the chuck, which feature was abandoned in the Model 6, Figure 22, already referred to, and later types.

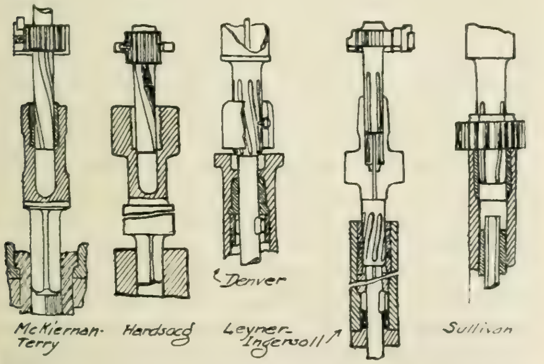


FIG. 23. HAMMER ROTATIONS OF MODERN DRILLS.

Figure 23 shows the rotations of various makes of hammer drills, which it will be noted correspond in main essentials to the Leyner type. In Figure 24 is shown the No. 7 Leyner Drill, which may be said to be the real father of all present day hammer drills. It includes in its design the Sergeant release rotation feature, the rifle bar rotating sleeve chuck feature, the water and air feature, and the first automatic lubricator, as well as enclosed-in-the-machine throttle construction, and one piece solid front head and finally, split front head with through bolt retained front head cap. It is interesting to note the variations of features of these designs as found in other makes of machines, as shown in Figure 25, including the mounted hammer drills, self-rotating hand ham-

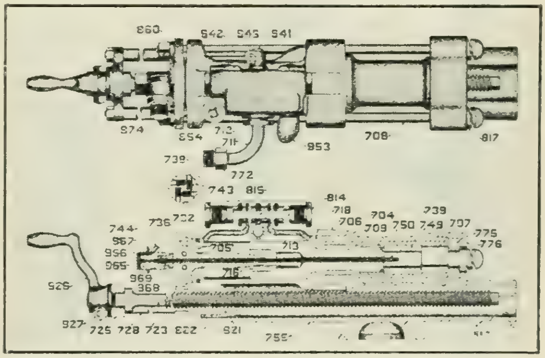


FIG. 24. CROSS SECTION NO. 7 WATER LEYNER DRILL, MODEL 6.

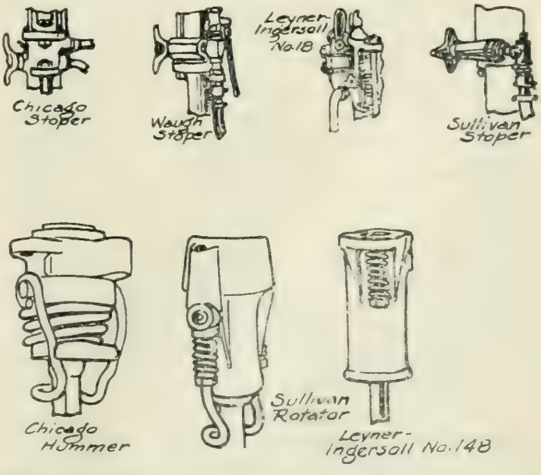


FIG. 25 THROTTLES AND FRONT HEADS OF MODERN HAMMER DRILLS.

mer drills and stoper drills with their air feed attachments as well.

The Leyner Drill has been used in such notable work as the Newhouse Tunnels, the Lucania Tunnel, the Los Angeles Aqueduct Tunnels, the Laramie Poudre Tunnel, as well as in some of the biggest mines of the country, numbering among others the Calumet & Hecla, Anaconda, Homestake, as well as many other large mines abroad.

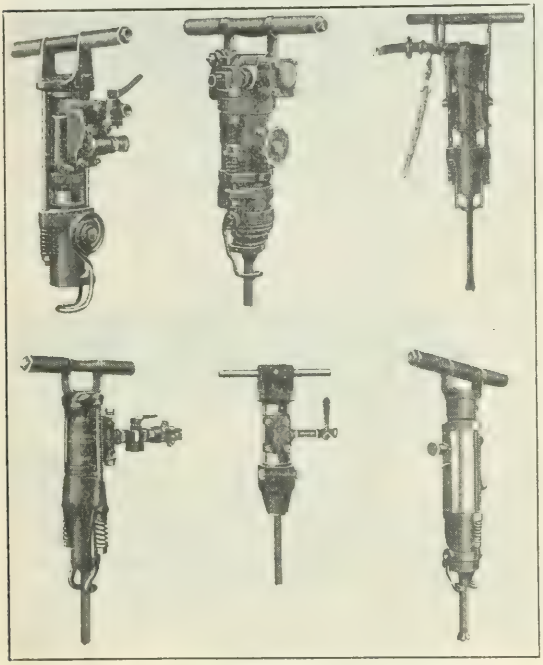


FIG. 26. MODERN SELF-ROTATING HAMMER DRILLS.

It is interesting to compare the advance which has been made in the self-rotating hand hammer drill, starting with Leyner's first experiment in 1909, shown in Figure 6, on through to the Ingersoll-Rand Co.'s various Jackhamer types, Sulivan Rotator, Denver Rock Drill Co.'s, Clipper Drill, Chicago Pneumatic Tool Co.'s, Hummer McKiernan-Terry Busy Bee, and many others, as shown in Figure 26.

DEEP MINE TEMPERATURES

At a recent meeting of the Midland (British) Institute of Mining Engineers an interesting communication from Mr. E. H. Clifford was read, describing conditions prevalent in the City Deep Mine, one of the largest and deepest of the Rand.

At the present time the workings, which are confined to the uppermost portion of the mine, extend over an area of approximately 10,000 ft. along the strike by 3,500 ft. on the dip, and the greatest vertical depth at present is 4,500 ft. On the Witwatersrand the temperature of the rocks increases at the rate of 4 deg. for every 1,000 ft. in depth, and the rock temperature at 4,500 ft. is 84 deg. This would not be at all serious were it not for the fact that the air, shortly after leaving the main intakes, very soon becomes saturated in consequence of regulations stipulating that all rock surfaces should be kept wet in order to prevent the dissemination of dust. A saturated air at a temperature of 84 deg. Fah. is scarcely supportable unless the air was in active motion, and this latter condition could not be maintained at every point, particularly in development ends.

They had therefore reached the limit on the City Deep, and had yet an additional 2,500 ft. to go when the new shaft is completed, and were faced with the necessity of reducing the air temperature from between 95 and 100 deg. Fah.—which it would be at 7,000 ft.—to about 75 deg. Fah. The principle that was being relied upon was the heat-absorbing capacity of the ventilating current of air due to evaporation and to its specific heat. Local cooling near the bottom of downcast shafts was, of course, taking place everywhere, but it generally remained local cooling.

ZINC IS ZINC

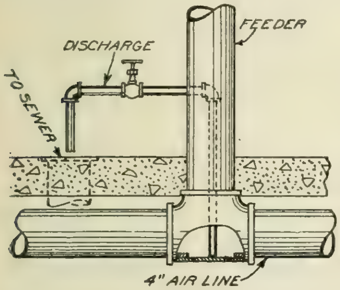
The American Zinc Institute recently formed, has, as one of its objects, to free zinc from its many nicknames, and is making an effort to discourage the use of such names as spelter, blende, jack, and like misnomers. The institute has now over 140 members representing practically every zinc mining and zinc smelting interest in the United States. Many trade journals, the United States Geological Survey, and the Bureau of Mines have already agreed to call zinc by its right name.

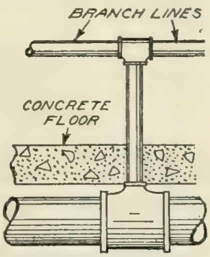
The Italo-American Union, a new trade organization of Italians interested in America, has recently come into existence. It is designed to furnish a centre for all Italo-American committees, and comprises economic intellectual, art, legislative, and press sections. The National Foreign Trade Council learns that behind it are the big financiers and commercial men of Italy, who hope to encourage the commercial and economic relations between the two countries.

The Association has obtained the beautiful mediaeval Palazzo Salviati on the Corso Umberto, and will provide there an information office for American business men, a library of American industry, and a central meeting place combining both business and social features.

Air for Pump Air-Chambers

THE FUNCTION of the air chamber and the necessity of its operative pressure in connection with the reciprocating water pump to ease the shocks due to the starting and stopping of the column of water in the pipe line with each stroke is so generally recognized that a pump without this appurtenance is a rare anomaly. Providing the air chamber, however, is not providing the air which should be operative within it, and at this late day it is being realized that air chambers will not provide the necessary air for themselves, and that they too frequently have little or no air when they should be and are assumed to be full or nearly full of the necessary elastic fluid. This matter is interesting and suggestively discussed by Mr. H. D. Fischer in the article which we here reproduce from the issue of *Power* for Aug. 5, 1919.





The function of an air chamber is to provide an elastic cushion to absorb the energy of the column of water leaving the pump, which has attained a velocity higher than the average during the middle of the piston stroke, and to feed out this energy again to maintain the velocity of the water in the pipe beyond the air chamber more nearly uniform during the period at the end of the stroke when the piston stops. To accomplish this most effectively, the air chamber should be arranged so that the moving stream of water flows directly into its lower end or is so guided into it that little energy will be lost by the eddying and disturbed flow of water making a sharp, unguided turn or attempting to return upon itself. It must not be lost sight of that it it is just as much the function of the air chamber to feed out the energy absorbed and thus maintain a reasonably uniform flow as it is to absorb the shock in the first place. A water gage should always be installed so that it is known there is air in the air chamber.

The illustrations show arrangements suitable to various locations, all of which will work satisfactorily, as has been proved in many installations. Of these, Fig. 1, where a riser turns into a horizontal run is probably the most desirable as it requires fewest fittings, these are all standard and in it the air column meets the flow most directly. Equally effective is that shown in Fig. 2, for use in horizontal runs. Many similar air chambers have been condemned because the baffle to direct the stream upward has been omitted. The baffle need not fit water tight, but should fit reasonably close and be firmly fastened by welding or screwed clips, as in long lines the pressure against it is considerable.

Arrangements shown in Figs. 3 and 4, where a horizontal line turns sideways or downward, are also good, but that shown in Fig. 5 should not be installed except where there is a supply of compressed air available for filling.

The best results are obtained by making the air chamber of the same size pipe as the feed line and obtaining the necessary volume by increasing its length. If it is made either larger or smaller, there will be an abrupt change of velocity in the water entering or leaving the air chamber, with a corresponding loss of energy and efficiency. For the average plant the dimensions shown on the sketches are ample, but for very long lines, such as occur in pumping plants, etc., the height should be considerably increased.

But no matter how well located the air chamber is, it must contain sufficient air to provide a cushion, and in plants where no supply of compressed air at or above boiler pressure is available this is often difficult to maintain, as the solvent power of water for air increases directly with the pressure. For instance, at 150 lb. it will dissolve eleven times what it would in an open tank, and any air in the air chamber rapidly disappears. Under such conditions it is custom-

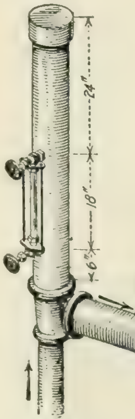


FIG. 1. AIR CHAMBER

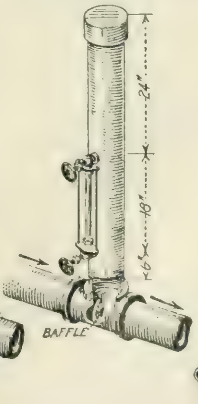


FIG. 2. BAFFLE IN TEE

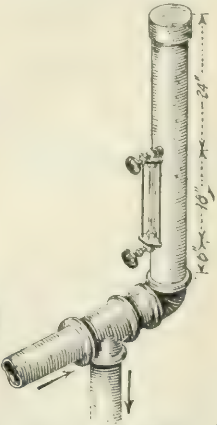


FIG. 3. ANOTHER ARRANGEMENT

ary to use the feed pump as a compressor, where the suction pressure is not too high, opening the water-cylinder drain-cock on the suction stroke, or with an open heater lowering the water level during a light-load period so that the pump sucks some air.

A slightly more elaborate but effective arrangement, devised by Mr. Merriam, master mechanic at the Methuen Co., Methuen, Mass., is shown in Fig. 6. This also has the advantage that by throttling the valve it can be arranged to deliver just the quantity of air required and will work indefinitely without attention. By means of the unions it could be quickly removed for the purpose of making repairs to the pump or for packing pistons.

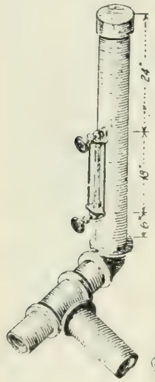


FIG. 4. A GOOD ARRANGEMENT

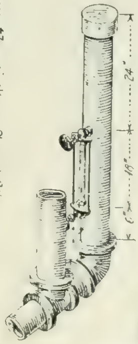


FIG. 5. REQUIRES COMPRESSED AIR

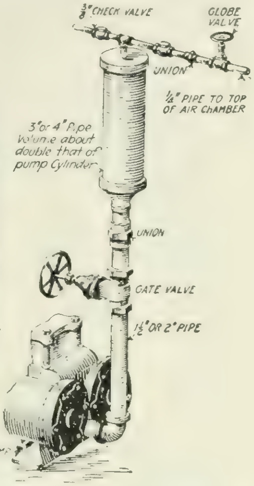

3/8" CHECK VALVE
GLOBE VALVE
UNION
1/4" PIPE TO TOP OF AIR CHAMBER
3" or 4" Pipe volume about double that of pump Cylinder
UNION
GATE VALVE
1½" OR 2" PIPE
FEED PUMP

FIG. 6. HOW AIR IS SUPPLIED

It is only very long lines, where the weight of the moving column of water is such as to cause severe shocks, or where pumps are in very bad condition and give a similar effect, due to reversed blow, that the need of air chambers is forcibly impressed on the operating engineers. They are, however, advisable under all circumstances and particularly where it is desired to measure flow by means of orifice, venturi or pitot-tube meters, as, by reason of the natural laws on which they work, pulsating flow will cause all of them to read high by varying amounts.

In all these meters the pressure difference which operates the recorder mechanism is proportional to the square of the rate of flow; that is, if the flow is doubled, the pressure difference operating the recorder increases four times. Owing to inertia of the meter mechanism and friction and inertia of the water in the recorder connecting pipes, the water acts like a throttled gage and shows a fairly steady reading, this reading corresponding to the average of all the differences of pressure corresponding to the flow at each instant.

But in a situation of this kind the higher rates of flow will have a great deal more than their proper share of influence on the averages, as what is being averaged is not the flows, but the pressure difference produced by them, which increases very much faster than the rate of flow. For example, if for half the time the flow were 5 ft. per sec., producing a pressure difference of 2 in. of mercury, and half the time 10 ft. per sec. with a pressure difference of 8 in. of mercury, then the average flow during the period would be 7.5 ft. per sec., but the average pressure difference acting on the recorder would be 5 in. of mercury, which would give a reading of 5 ft. per sec., or about 5.5 per cent. high. If the flow were nothing half the time and 15 ft. per sec. half the time, giving the same average of 7.5, the average pressure difference would be 9 in. of mercury and the recorder would read 10.6 ft. per sec., or 41.4 per cent. high.

Thus it will be seen that the wider the variation in rate of flow the greater will be the error of the rate of flow meter unless proper air chambers are provided to reduce the pulsations and produce a reasonably steady flow.

Reducing the fluctuations in flow by means of an air chamber is the only correct solution for problems of this kind. While experiments could be made and the meters calibrated to correspond to the conditions found, yet if the load, or particularly the condition of the pump and valves, changed, so that, for example, there was a slightly reversed flow, due to a defective valve on one pump stroke, this effect and its correction, which may very properly be called its pulsation factor, would be entirely different and require recalibration of the meter, while if proper air chambers are installed and it is seen that these are kept filled with air, the original meter calibration may be relied on and may be checked against steady flow at any time.

The following concise and pithy expressions appeared in *Power* recently and are well worth being passed along: Adaptability means doing the next best thing in the handiest way. Efficiency is knowing just how and fitting it to just when. Loyalty consists in being decently considerate of the boss. Responsibility lies in having grit enough to risk a call down. Opportunity is the same thing as being born lucky. Reliability shows the capacity for staying put longest. Integrity is the Sunday name for plain weekday honesty.

Vitiation of Garage Air and Its Dangers*

AMONG THE investigations conducted by Bureau of Mines there have been several relating to the dangers attending the use of gasoline for fuel and other purposes. Among these dangers is that of the vitation of the air in inclosed places, such as mines or automobile garages, by the carbon monoxide in the exhaust gases of an internal combustion engine burning gasoline.

The occurrence of a number of accidents, some of them fatal, whereby people have been overcome through breathing air fouled by the exhaust gases from automobile engines, discloses a hazard that is more serious than it is generally thought to be. Automobile engines frequently run in garages for considerable periods of time, and the exhaust gases, unless removed by proper ventilation, may make the atmosphere of the garage unsafe. Running an engine in a garage is particularly hazardous in winter when the weather is too cold for keeping doors and windows open.

Carbon monoxide is a colorless, odorless and tasteless gas. It is extremely poisonous, because it combines with the red coloring matter of the blood more readily than oxygen does, and blood that is saturated with it can not take up oxygen. Exposure to an atmosphere containing only 0.20 per cent will cause a man at rest to collapse within an hour, and exposure to as little as 0.05 per cent causes headache in several hours' time. Different people are affected differently, and a man at work will be overcome much more rapidly than a man at rest. The dangerous symptoms come almost without warning, and collapse in a garage would prove fatal unless outside aid arrived very soon, because the running engine would continue to generate carbon monoxide and continue to make the air more poisonous. One of the authors of this paper was extremely ill for eight hours after exposure for 20 minutes to air containing 0.25 per cent of carbon monoxide.

When a person is found overcome in a garage throw the doors wide open and remove the person to fresh air at once. If a tank of oxygen and a breathing mask are at hand and the person is breathing, administer oxygen through the mask for 20 minutes. If the person is not breathing, give artificial respiration by the prone pressure or Shaefer method. Do not delay. Do not wait for the doctor or for artificial respiration apparatus. Begin at once.

Lay the victim on his belly with his face to one side, so that his nose and mouth are free for breathing. Place one of the victim's arms and hands straight out beyond his head, the other under his head. This position helps to expand his lungs.

Kneel, straddling the victim's thighs and facing his head; rest the palms of your hands on his loins (on the muscles of the small of his back), with your thumbs nearly touching each other and with fingers spread over his lowest ribs.

With arms held straight, swing forward slowly, so that the weight of your body is gradually, but *not violently,* brought to bear upon the victim. This act should take about two seconds.

Then, leaving your hands in place, swing backward slowly, so as to remove the pressure, thus returning for two seconds to the first position.

Repeat deliberately 16 to 20 times a minute the swinging backward and forward—a complete respiration in about four seconds. Keep the movements in time with your own breathing.

While the artificial respiration is being continued, have an assistant draw forward the victim's tongue, if it has fallen back (fortunately it usually falls forward when the victim is face down). Hold the tongue out, if it tends to draw back, by wrapping a handkerchief around it. The handkerchief may also protect the assistant's fingers from being bitten. The assistant should also loosen any tight clothing around the victim's neck, chest, or waist.

Do not permit bystanders to crowd about and shut off fresh air. Keep the victim warm with proper coverings and by placing beside his body hot bricks, bottles, or rubber bags filled with warm (not hot) water. Wrap bricks, bottles, or bags so as to prevent burning the victim.

Continue the artificial respiration *without interruption* until natural breathing is restored, or for at least three hours. If natural breathing stops after being restored, use artificial respiration again.

Do not give any liquid by mouth until the victim is fully conscious. Keep the victim flat. If after being partly resuscitated he must be moved, carry him on a stretcher. It is dangerous to make an ill person sit up or stand. To make him walk may cause death.

When gasoline is burned in the presence of enough air, the carbon is almost entirely converted into carbon dioxide and the hydrogen into water. If, however, the amount of air is not enough, besides carbon dioxide and water, carbon monoxide, hydrogen, and methane are formed. As these three gases are all combustible when mixed with air, their presence in the exhaust represents waste. Hence the presence of large amounts of carbon monoxide in the exhaust is to

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Abstract from Bureau of Mines Technical Paper 216, by G. A. Burrell and A. W. Gauger.

be deprecated as regards both efficiency and safety. The carbon dioxide is at its maximum when 2.5 per cent of gasoline vapor is contained in the mixture prior to combustion. From that point the carbon dioxide decreases and the carbon monoxide begins, the latter reaching a maximum at 4.1 per cent of gasoline vapor. The range of complete combustion is very narrow, between 1.5 and 2.5 per cent, so that it is almost impossible to run an engine without producing carbon monoxide at times. Watson has shown that carbon monoxide begins to form with mixtures of 14 parts air by weight to 1 part of gasoline, and increases to about 12 per cent at 9 parts air to 1 of gasoline.

THE INDICATOR CORRECTS THE COMPRESSOR

The indicator diagrams here reproduced suggest at once how mistaken may be our comfortable assumption of air compressor efficiency in any individual case and pointedly call attention to the importance and value of indicator revelations. The diagrams were contributed to a recent issue of *Power* by Mr. R. McLaren, Toronto, Ontario, and his narrative follows:

While watching the valve gear of a 33x36-in. air compressor perform recently, the inlet valve at one end appeared to be closing late. Turning the engine over by hand slowly, I found that the piston had traveled one inch when the valve closed. The compressor is equipped with an inlet valve the opening of which is effected by a cam and the release by a separate eccentric. The discharge valves are of the poppet type, and the machine ran 54 r.p.m. at the time.

The loss of one inch of the stroke meant a loss of 26.7 cu. ft. of air per minute. That in itself was worth saving, but suspecting that the effect of inertia on the closing would make the loss more serious, I rigged up an indicator connection and got diagram, Fig. 1, which showed that before closure was complete the piston had traveled 6½ in. This indicated a loss of 173.6 cu. ft. per minute, or 18 per cent. for one end. Advancing the closing eccentric resulted in the diagram, Fig. 2.

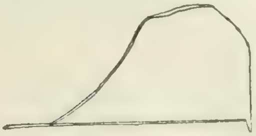


FIG. 1.

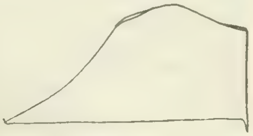


FIG. 2.

This compressor is one of a pair driven by two engines connected to a common shaft with the cranks set at 90 degrees. The unloaders were set to operate one end of each compressor at the time, the unloading being abrupt and complete and the valve remaining open during the unloaded period. The governor was equipped with an oil dashpot.

When I took charge of the plant, the governor was out of commission, the engines running on the throttles; the unloaders were also out of service. After getting the governor fixed, I foolishly filled the pot with cylinder oil, thinking that would give better results in regulating. Not so, however. At every operation of the unloader the speed would increase until the governor would get control of the situation, and perhaps by that time the unloader would be ready to dump the load on again, when the speed would go in the opposite direction.

I exchanged the cylinder oil for engine oil. There may have been some improvement, but I couldn't notice it. In desperation I disconnected the dashpot from the governor with the result that the regulation is about as even as one could wish it to be, but the governor is a busy one.

FOR DRAINING COMPRESSED AIR MAINS

The drawing off of the water which accumulates in air mains that have a long horizontal run should always be provided for, and advantage should be taken of low points where the water will collect, or pockets or enlargements of the pipe may be provided for the purpose. It is always well to remember, however, that while the depressions within the pipe are necessary for drawnig off the water, such depressions are not needed outside the pipe for the water to run off, as the air pressure can be taken advantage of to deliver the water almost anywhere.

E. C. Pratt shows in *Power Plant Engineering,* by the sketch here reproduced, and which explains itself, how he rigged up to get rid of the water. The ½ in. water line discharging into the sewer was brought to within a small fraction of an inch of the bottom of the main, and the valve could be opened occasionally to draw off the water.

In the 106 years between 1807 and 1913, and including those years, American mines produced a total of 9,844,159,937 tons of coal. In the succeeding five years the mines turned out 2,960,938,597 tons of coal, almost one-third as much as was mined in the entire 1807-1913 period, and almost one-fourth of all the coal mined in the United States since records have been kept.

A writer in *Railway Age* cites figures of record showing that it cost a certain big railroad $21,849 to scientifically ascertain and determine that it costs one-tenth of one cent to drive a track spike.

Utility Street Railway Trucks

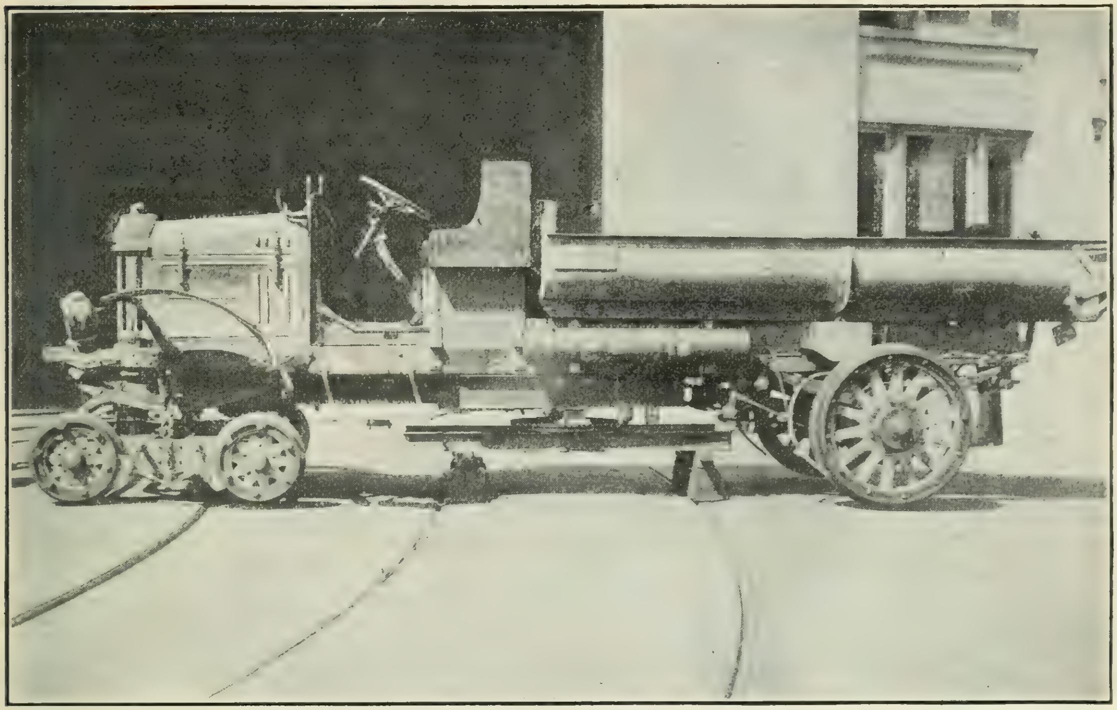


FIG. 1—UTILITY COMPRESSED AIR TRUCK

The two photos here reproduced show samples of a fleet of motor trucks which have been equipped with flanged wheels and are operated on the Hetch Hetchy railroad by the City of San Francisco. They are variously equipped or can be readily changed according to the service required.

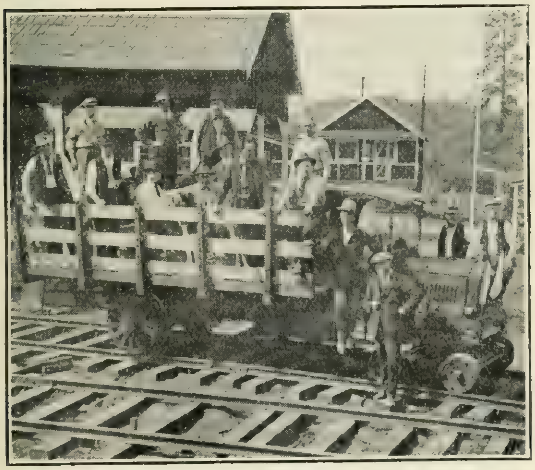


FIG. 2—TRUCK FOR FREIGHT OR PASSENGERS

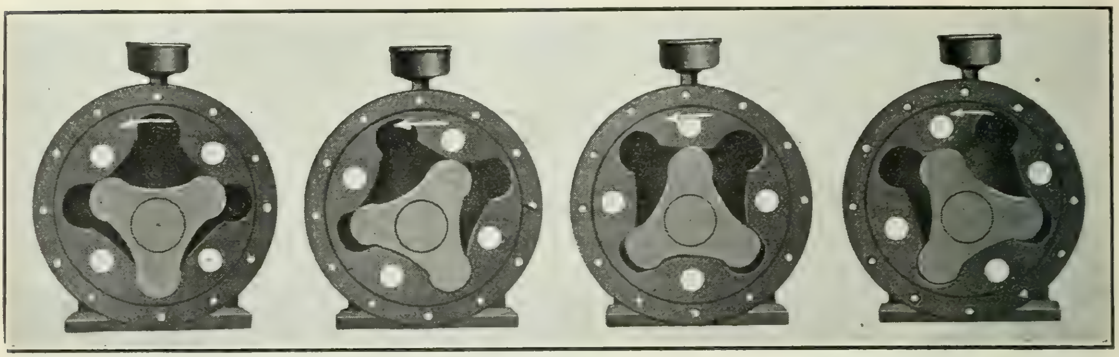
Fig. 1 is equipped with air sanders operated from an 8 in. by 35 in. horizontal air reservoir seen in the middle of the machine and charged by a four cylinder Kellogg pump installed inside the engine hood.

This truck has a dumping body, and under the center of it is permanently carried a turntable which is clearly shown. When it is necessary to turn the truck or to lift it off the rails the turntable is jacked up—or rather down—until the truck wheels are clear, and then the machine can be reversed or otherwise turned as desired. Fig. 2 shows another of the trucks rigged for hauling express or for carrying gangs of men to their work.

Because of the law prohibiting the employment of boys in the anthracite mines of Pennsylvania, the operating companies are employing old men in their places, as slate pickers, jig operators, chute tenders and oilers in the breakers.

There are nearly 35,000 fewer horses in service in New York City than there were two years ago, a reduction of more than 30 per cent.

An Ingenious Rotary Pump or Blower



THE INTERESTING pump or blower here shown was exhibited at the annual show of the Royal Agricultural Society of England by Fielding & Platt, Limited, Gloucester. The pump is the invention of Mr. E. Fenerheerd, Bath, and for the illustration we are indebted to *The Engineer,* London. The four rotative positions shown leave little call for additional explanation. The four pocketed ring which fits easily in the circular case, and the rotating triangular impeller are enclosed within the plates which form the covers of the case. It will be noticed that the driving shaft which carries the impeller is located below the center of the case. The inlet and discharge openings are located in either or both of the covers, extending but little above the center line. With the rotation as indicated by the arrows the discharge would be on the left side and the intake on the right.

As there are no valves or other parts to wear or get out of order this should be a very satisfactory pump for water and a quite effective blower, but it could not be expected to be so successful as a high pressure air compressor.

A COMPRESSED AIR JET AS A FIRE SCREEN

A German technical paper treats of methods employed for screening furnaces. Workers who have frequently examined what is going on in the intensely heated and glowing masses suffer much from the heat radiated and various devices have been tried for relief. Hollow, water cooled furnace doors afford protection only when closed. Devices have been installed for drawing off the hot air in front of furnaces by centrifugal exhausters, the objection to these being that the workers are subjected to too great and sudden changes of temperature. The most effective arrangement is to fix immediately behind the furnace door a narrow, oblong nozzle through which cold air is blown upward, thus interposing a screen of relatively cool air between door and furnace. This arrangement is to give adequate protection to the worker, and has the incidental advantage that when the doors of the furnace are opened the escape of flame is checked.

TERMINAL IMPROVEMENTS FOR JAMAICA BAY

We read in recent announcements that Alton H. Greeley, one of the principal warehouse owners in Cleveland, who is also connected with the controlling interests of the Baltimore & Ohio Railroad Company, is to head a new $100,000,000 syndicate which will construct warehouses and piers on Jamaica Bay. In view of the fact that the Baltimore & Ohio Railroad is affiliated with the Pennsylvania Railroad it is considered probable that a freight tunnel may be constructed under the Narrows from Bay Ridge to Staten Island, there connecting with the main lines of the companies crossing the state of New Jersey.

Dock Commissioner Hulbert was directed this autumn to prepare a bill covering dredging in Jamaica Bay. The bill will be submitted to Congress after it has the approval of the Sinking Fund Commission. The bill provides for a main channel 1,500 feet wide and 30 feet deep, and an interior channel 1,000 feet wide and 30 feet deep.

The Co-Operative Mining Company of Lordsburg, New Mexico, in straightening its shaft on its property fifteen miles north of that place, encountered a body of native silver ore five feet from the surface. The lode is seven feet in width and assays show values of from $1,200 to $1,500 to the ton.

Compressed Air on San Francisco Docks

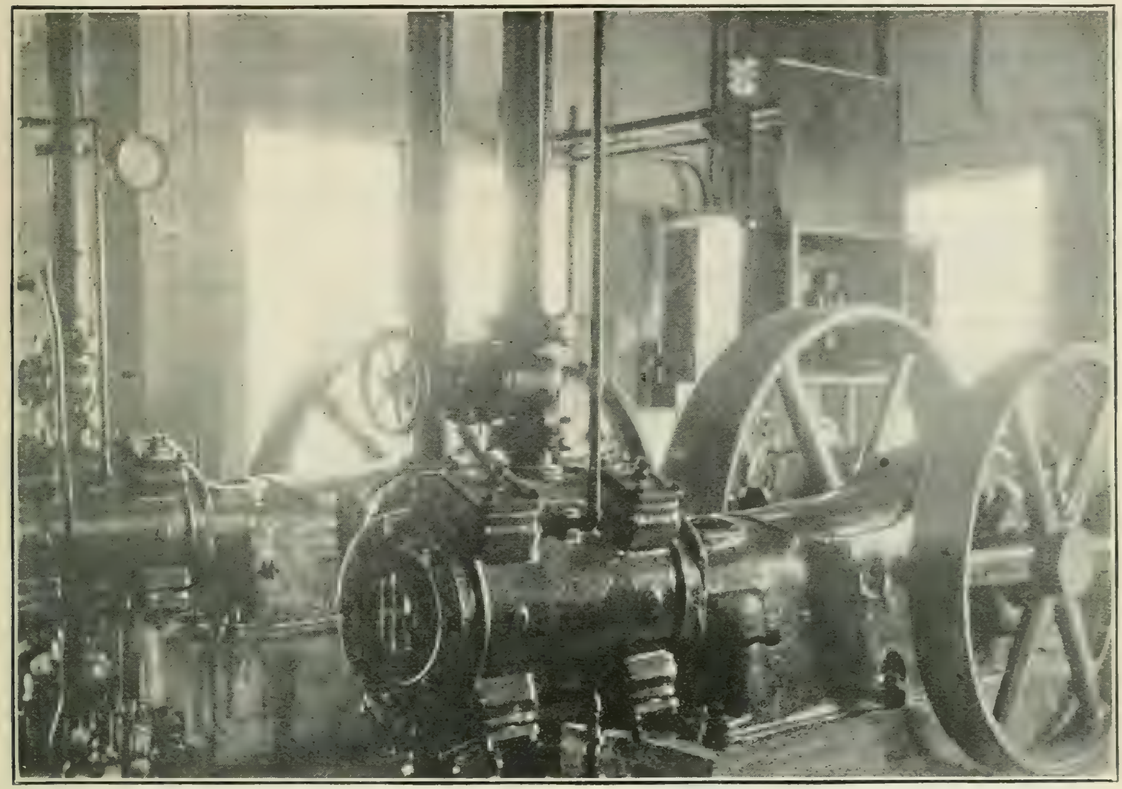


FIG. 1—THE COMPRESSOR INSTALLATION

The two photos here reproduced have to do with a novel use of compressed air. Fig. 1 shows two single-stage belt driven Ingersoll-Rand air compressors installed by the W. R. Grace Company on their docks at San Francisco, and Fig. 2 is a close-up view of piping and valves at the edge of the pier. The installation is initially employed for the handling of cargoes of cocoanut oil. Cocoanut oil, by the way, is not always oil, but solidifies like lard when it becomes cold. It comes from the Orient in large tanks built into the ships, and in order to pump the oil out it must be heated by steam coils.

When the vessel ties up connection is made from the tanks on the ship to the pipe system leading to the storage tanks on shore, and powerful pumps quickly drive the oil ashore. As soon as the oil is all expelled from the tanks compressed air is turned into the pipes which clears them of the oil remaining. This is done immediately, for if the oil were permitted to cool and harden it would be necessary to take the pipes apart to clean them. Another firm formerly pumped water into their pipes to clear them, but after seeing the success of W. R. Grace & Company they also installed a compressor. The air from these compressors is used also to drive the boiler feed pumps, and is also supplied to several piers in the vicinity to be used by different ship owners for repairing, hoisting and other purposes.

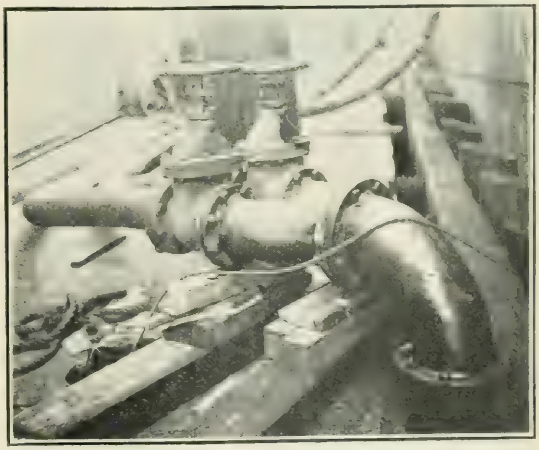
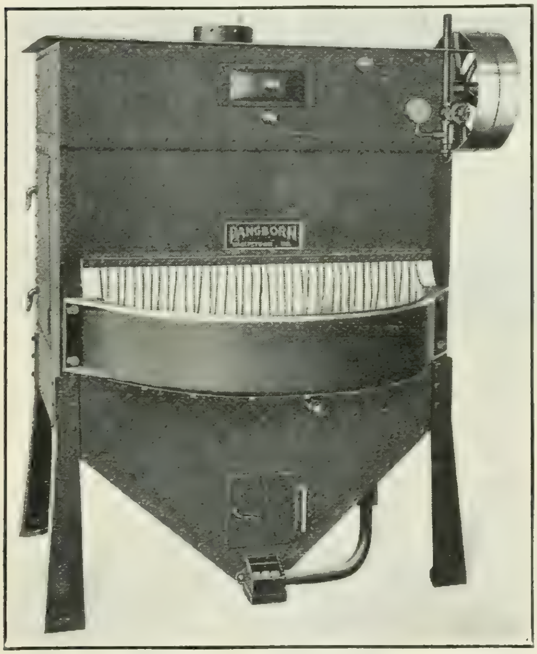


FIG. 2—PIPING ON THE PIER

NEW ROTARY TABLE SAND-BLAST MACHINE

We show here an improved sand-blast machine of the rotating table type, the latest output of the Pangborn Corporation, Hagerstown, Md., and first exhibited at the recent Foundrymen's Convention.

The rotating table, as will be seen, is half exposed and half in a dust tight heating in which the blasting action takes place. Work to be cleaned is placed upon the front of the table, turned as required, removed and renewed while the operation of the machine goes on continuously. The sand-blast action is of the suction type, the spent abrasion falling through the grated top of the table and being returned to the blasting service again without interruption.



The blast projector takes nozzles interchangeably from ⅛ in. to 5/16 in. and at 80 lb. pressure. The air consumption with the smaller nozzle is as low as 21 cu. ft. of free air per min. and the entire power for driving the table is little over 1 h. p. The machine is thus adaptable to the smaller shop as also an admirable auxiliary for special uses with larger equipment.

The table top is 42 in. diameter with a 4 in. high guard which serves as a retainer for small work, which otherwise might be dislodged or blown off by the blast; and with a 10 in. vertical opening for the passing of the work in and out of the blasting zone it is available also for pieces of considerable size and weight. The opening through which the pieces pass from the exposed portion to the blasting zone is closed by multiple pendant flexible rubber curtains which retain the flying abrasive and dust, making it a hygienic machine and available for installation with other machine tools without detriment.

OIL ASPHYXIATION DANGERS

According to a memorandum issued by the marine department of the British Board of Trade, cases have been reported recently in which men employed in cleaning or carrying out repairs in oil tanks, or in working cargo in holds situated above double-bottom tanks in which fuel oil is carried, have been asphyxiated or poisoned by the fumes or gases given off from the oil or cargo. To guard against such accidents, the Board of Trade has issued the following recommendations:

When fuel oil is carried, whether in double bottoms or elsewhere, care should be exercised that the tanks containing the oil are thoroughly oil-tight. The utmost care should be taken to ventilate thoroughly all spaces in which oil has been carried, as well as any adjacent spaces in which vapor may have accumulated, before men are allowed to enter such spaces. Thorough ventilation is necessary in all cases.

THE DANGER OF EMPTINESS

Two fatal accidents due to the explosion of so-called empty drums which had contained petroleum were reported to the Government (British) Inspectors of Explosives during the past year. In one case the drum had but recently been emptied, but in the other steps had been taken to remove all trace of petroleum by thoroughly washing out and rinsing the drum. The victim of the explosion, an experienced chemist, then put a light to the bunghole, either to prove that no inflammable vapour remained or to burn out the residue, and a violent explosion followed. This accident is one more indication of the difficulty of rendering safe a vessel which has contained petroleum spirit, owing to the density of the vapour, which is about two and a half times as heavy as air, and to the very small proportion of vapor required to make an explosive mixture with air.

Rubber is one of the few commodities which has not advanced in price since the war began. The average New York wholesale price for Para Upriver fine grade in 1913 was about 92c. per lb. In July, 1919, the price was 55c.

DOUBLE SUCCESS OF AN AIR REHEATER

The Spicer Manufacturing Company, operating a thoroughly up-to-date factory at Plainfield, N. J., quite naturally use considerable compressed air, the most voluminous call for which being for the oil burners of their heating and annealing furnaces, and for sand blasting operations.

Their air compressor, an Ingersoll-Rand superial Type X P V, piston valve, steam-engine-driven machine, with a rated capacity of 1,150 cu. ft. of free air per min., compressed to 50 lb., was installed late in 1915. As usual, the demand for air soon increased, so that as far back as July, 1917, it became necessary to speed up the compressor from 200 to 225 r.p.m.

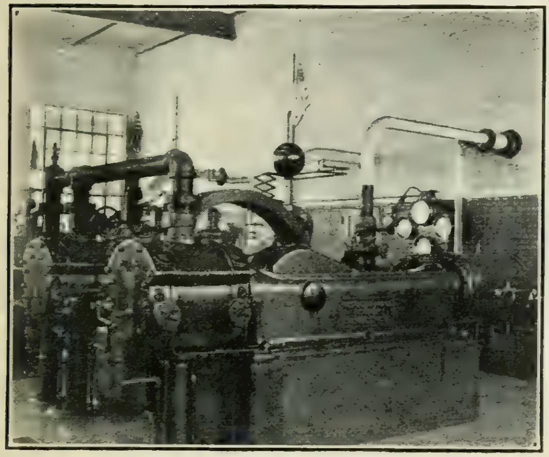


Photo courtesy the Ingersoll-Rand Co.

COMPRESSOR INSTALLATION OF THE SPICER MANUFACTURING CORPORATION, PLAINFIELD, N. J.

Even this acceleration not proving sufficient, after first considering the alternative of installing a second compressor, and immediate relief being imperative, it was decided to place a reheater on the sand blast line and thus increase the volume of air delivered enough to carry over the peak. It was considered at the same time that with this temporary relief it would be possible in a comparatively short time to rearrange a portion of the oil furnace layout and thus reduce the air consumption in that department.

The reheater proved at once a complete solution of the problem of getting more air at a minimum cost and at the same time it eliminated another serious trouble in the sand blast room, the entire matter being clearly stated in the following extract from a letter of Mr. C. W. Spicer, Vice-President of the Spicer Manufacturing Corporation:

"From 50 to 75 per cent. of the output of the compressor is passed through the reheater. A very light coke fire, consuming about a bushel of coke in 24 hours so expands the air as to reduce the consumption by 25 per cent., and at the same time it eliminates the serious trouble caused by the moisture in both the air and the sand.

"Before installing the reheater we were compelled to take every possible precaution to avoid the moisture in the air, in the sand and on the surfaces of the work, and even then on damp days the sand would pack and things would all go wrong. With the reheater in use we do not need to think of the moisture question. No attention is paid to drying the sand before replenishing the supply in the machine, as the necessary quantity of new sand may be added more or less indiscriminately even though very damp, and the moisture will be absorbed by the warm sand already in the machine without any difficulty whatever. The forgings to be sand-blasted may be brought in from out of doors, not only wet but frequently in the winter carrying considerable snow, all without any trouble from the moisture.

"The expense and trouble of operating the reheater is infinitesimal as compared with the troubles which it completely eliminates. The upkeep on the reheater is practically nothing on account of the slow heat required."

CORRECTING A CONTINENTAL CLIMATE

It is proposed—and the proposition is regarded as not too chimerical for serious discussion—to construct a dike across the strait between Belle Island and the Newfoundland mainland. The purpose would be to turn the Labrador current out into the Atlantic and induce the warm Gulf Stream to flow into the Gulf of St. Lawrence. Although Newfoundland is as far south as England, its ports are ice-bound in winter because of this icy Labrador current which refrigerates the climate and shuts off the warm Gulf Stream which makes England so green. The proposed enterprise should, if successful, give eastern Canada a hot water system of heating its climate and make it like that of England.

F. V. Sargent has been appointed by the Chicago Pneumatic Tool Co. district manager of sales in the Boston territory, succeeding F. S. Eggleston, with headquarters at No. 182 High street, Boston.

In order to offset the war loses of 45 ships, aggregating 389,853 tons, the Cunard Line has build a total of 426,800.

OXY-ACETYLENE TORCH CUTS GRANITE

In repairing a drawbridge across the Passaic River, at Newark, N. J., it became necessary to remove a casting and pin from a granite pier. After several unsuccessful attempts to draw the pin, as narrated in Stone, the pin projecting down 3 inches into the masonry, it was found necessary to cut a trench in the hard granite so that the casting might be shifted laterally to one side for removal and replacement by a new and larger center casting. This trench was 4 ft. long, 9 in. wide and 3 in. deep, extending under the old casting. The cutting of the trench would have been an endless task had it not been discovered that an oxyacetylene flame chipped the granite quite readily and could be used under the old casting without damaging the balance of the masonry. The desired channel was thus quickly obtained. The flame was also used for cutting away the abutment back of the fixed span bottom chord to provide expansion clearance.

COMPRESSED AIR FOR DELIVERING SAND

The California State Board of Harbor Commission has recently completed a system of delivering sand to the locomotives of the Belt Railroad by means of compressed air. The sand is shoveled into the steel drum seen in Fig. 1 and is forced upward through the delivery pipe seen at the left, using air at a pressure of about 45 lb. The drum has a conical top slanting downward toward a large hole in the center which is closed by a suitable valve or cover suspended from above by a rope. The sand is shoveled into the drum until it is nearly full when the cover is lowered into position and is clamped by turning the cross handles shown in the photo. Then the air is turned on and the sand is sent up through the roof of the building and is conveyed by the telescoped and jointed pipe seen in Fig. 2 for delivery to the locomotives as required.

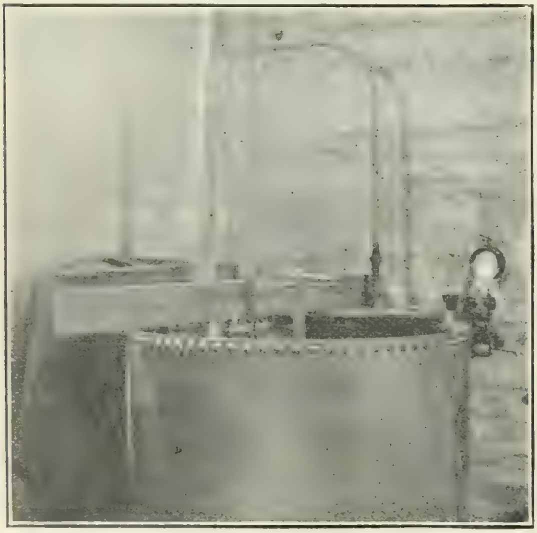


FIG. 1—THE PRESSURE DRUM

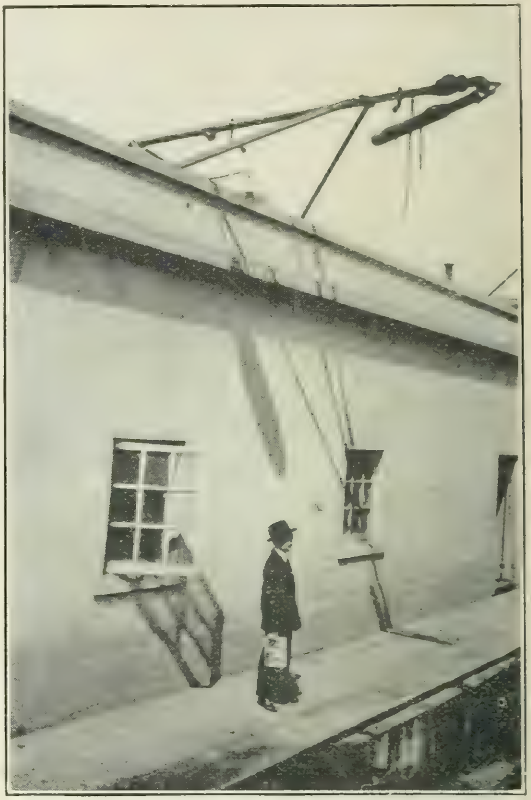


FIG. 2—THE DELIVERY PIPE

In sinking a mine shaft at Kendall, Montana, through old heavy timbering the wood was cut very handily by using a wood chisel with a cutting edge 2 in. wide and operated by a Jackhamer drill arranged to work without rotation. This was used for cutting off logging, planks and ends of timber, which was accomplished rapidly and easily.

Chalk production of England is between 4,000,000 and 5,000,000 tons, with an approximate value of 10½ cents per ton. The output for 1913 was 4,458,126 tons, worth £213,479, of which 2,796,857 tons came from the county of Kent.

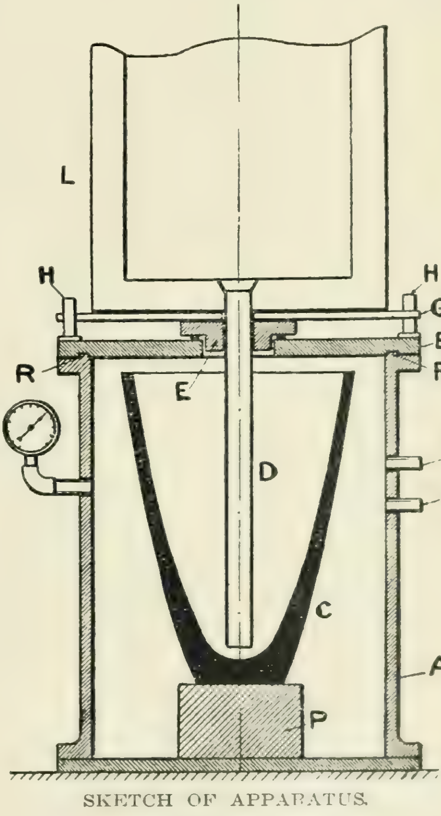
Air Pressure for Metal Casting

What follows is a small portion, in an abridged form, of an important paper by W. Rosenhain, F. R. S., and D. Hanson in the Transactions of the Institute of Metals.

During the last four years the Metallurgy Department of the National Physical Laboratory has been called upon to prepare a series of alloys of copper for certain special and most exacting requirements. Various alloys in a wide range of proportions were attempted to be produced and the most difficult and responsible operation was quite naturally the melting and the casting of the samples. Even when the greatest care was taken, and every precaution was taken to prevent the entrance of dross, it was found difficult to obtain ingots with satisfactory surfaces. The obvious remedy seemed to be to cast the metal by tapping it from a point well below the surface, and the most satisfactory method appeared to be the forcing of the liquid metal, by means of externally applied air pressure, through a feeder tube communicating with the bottom of the mold and dipping into the molten metal nearly to the bottom of the crucible.

In order to carry out this, it is necessary to use a previously heated feeder tube, through which the metal can be forced without splashing and without exposure to the atmosphere, the dross, charcoal, etc., being left behind in the crucible. The amount of metal in the crucible must be so adjusted that the mould is filled before the bottom of the feeder tube is exposed, and the air pressure on the metal must be maintained until the ingot has become solid.

The apparatus used is illustrated diagrammatically in the accompanying engraving. A is a cylinderical cast iron vessel closed at the bottom, while the upper end is open and has an external flange. The crucible C stands on a fire-clay support P. The top of the cast iron vessel A is closed by means of a lid B, which is provided with an annular recess R, fitted with an asbestos washer for the purpose of making an air-tight joint with the top of the vessel A, to which it can be tightly clamped by means of a number of screw clamps—not shown in the diagram. The centre of the lid is provided with a hole 3 in. in diameter, into which fits a circular flange piece of steel E, which is screwed to the iron tube D, ¾ in. in internal diameter. This is the feeder tube, and its length is so arranged that it reaches nearly to the bottom of the crucible C. The steel piece E is separated from the lid by another asbestos washer, the object being to form an air-tight joint and also to reduce the loss of heat from the tube D to the cold lid of the vessel. The feeder tube and its holder are held in position by the clamping bar G, which consists of a flat strip of steel slotted in the centre to take the top of the tube, and near the ends to enter corresponding slots in studs H H. The clamping is performed by slipping the centre slot over the projection of the tube, and springing the plate until it is possible to engage the end slots in studs H. H. The "spring" of this strip, together with the weight of the mould, are sufficient to hold the tube in place against the internal pressure in the vessel A. A two-part mould L, fitted with a hole in the bottom, fits over the projecting part of the tube D. The pressure vessel A is connected with a compressed air main through the inlet M, the supply being regulated by means of a delicate needle valve; an exhaust valve N is also fitted. A pressure gauge S is provided.



SKETCH OF APPARATUS.

The requisite amount of metal is melted in the manner described above, except that it has been found convenient to add the aluminum while the crucible is still in the furnace; this is done because it was found necessary for this method of casting to work at somewhat higher temperatures. When the last addition has been made the crucible is moved to one side of the furnace, and the feeder tube with its steel flange screwed in position is inserted into the furnace and left there until it has reached a bright red heat. The pot is then removed from the furnace, rapidly skimmed free from most of the charcoal, and a little cryolite is thrown on to the surface. The crucible is then placed in the pressure vessel, the surface of the metal being again skimmed to leave the centre portion as clean as possible for the entrance of the feeder tube. The lid is then placed in position and clamped on. While this is being done the runner tube is taken from the furnace, placed in position, and clamped. Then the previously prepared mould is carefully lowered into place. During these operations the exit valve N is left open in order to allow of the escape of the expanding air caused by the heating of the air in the vessel by the hot crucible, feeder tube, etc. As soon as the operations are completed this valve is first closed and then air is slowly admitted to the vessel from the compressed air main. The metal rises in the feeder tube and flows into the mould, the pressure of the air being regulated in such a manner that the mould is filled gently and without splashing. When the metal approaches the top of the mould the rate of flow is gradually reduced, and is almost arrested, the last stages being carried out very slowly. At this stage a crust is formed on the top of the ingot. As soon as this is sufficiently thick, the pressure is gradually raised in the vessel to 30 lb. per square inch, and is maintained at that value until the ingot is solid. The pressure is then released, the clamping bar removed, and the ingot mould with the feeder tube attached is removed from the vessel. The liquid residue in the crucible can then be cast into small ingot moulds. The mould is then opened and the runner removed from the ingot by cutting off with a saw.

A GRADUATE OF THE SCHOOL OF EXPERIENCE SHOWS THE WAY

Illustrative of the value of a detail of practice, there recently came to the editor's attention the following incident. A centrifugal pump for irrigation had been installed in a deep well pit. The engine was started and it pumped water for a few minutes. Then it began to "lose its vacuum" until it ceased to draw any water. A graduate engineer of several years' experience was sent by the pump manufacturer to remedy the defect. He went over the pump carefully, lifted the pipe from the pit and "calked" a few leaks at the joints. Still the pump would not work. He then declared that the trouble was with the well and not with the pumping outfit. So the owners drilled another expensive well. But the same trouble occurred with it, in spite of the fact that the well was larger and appeared to be capable of yielding a great volume of water. The hydraulic engineer was appealed to again, but with the same negative results. Finally an "uneducated" plumber suggested that he could make the pump work. He capped certain connections, and tested the pipe line by filling it with compressed air from an automobile pump. Major leaks in the joints were quickly discovered, and minor leaks were found by squirting oil over the joints, the oil bubbles indicating leaking air. Finally all joints were heated with a blowpipe, and an ordinary candle was held against the hot metal. The melting candle plugged every leak, and thereafter the pump worked perfectly.

The editor of *Engineering and Contracting,* who writes the above, rubs it in as follows: In this case who was the better educated man, the "uneducated" plumber or the "educated" hydraulic engineer? The former solved a problem that the latter had failed to solve. The former saved two wells. The latter would have made them worthless, and worse, for 320 acres of land would have been unproductive. The land is now worth $60,000, because the wells are productive.

TO REPLACE GERMAN CRAFT WITH NEW TRANSPORTS

It is announced by the New York *Journal of Commerce* that John Barton Payne, as chairman of the Shipping Board, has made an agreement with the War Department for the construction of twelve transports of 7,500 tons deadweight each, to replace the German passenger tonnage now being used by the Navy for transport purposes. These vessels will be used by the War Department to replace ships of similar type which were in service at the beginning of the war and are now unfit for further use.

It is stated in Washington that the next recommendation from the Navy Department to Congress will include a request for the construction of a small number of submarines with a cruising radius of at least 4,000 miles. Naval architects have been working upon the development of this type of undersea craft, studying German and Allied fighting submarines as well as the submersible cargo vessels which were used in running the blockade maintained against Germany .

The amputations of limbs among American soldiers during the war were less than 4,000, while it is stated that in connection with American industries there is an annual total of 26,000.

COMPRESSED OXYGEN SAVES SEVEN LIVES

A gang of seven men that took refuge in a compartment of the hold of the Ward Line S. S. *Guantanamo* in Brooklyn recently to escape from ammonia fumes coming from a tank, the head of which had blown out, were rescued through the quick wit of another gang engaged on a job of welding. The welders were at work on a barge alongside the same pier when the news of the accident reached them. The seven men were part of a crew of twenty-five engaged on the repair of a condenser. Under too great pressure, an ammonia tank in the engine room gave way, flooding the room in which the men were working. All but the seven managed to scramble to safety to the hatchways and upper deck.

Cut off from exit, the seven retreated to a compartment far down in the hold, from which they signalled their location by rapping loudly on the plates with their hammers. Their predicament was grave, as the fumes of ammonia, filtering through the crevices, slowly filled the room and made breathing more and more difficult.

The welders rose to the situation by cutting a hole through to the compartment where the men were imprisoned and thrusting down a compressed oxygen pipe line used on their new job. This not only served to blow away the ammonia fumes from the men, but supplied them with comparatively fresh air to breathe for the period of a half hour. Meantime the fire department had been called and Battalion Chief James Heffernan and his chauffeur, Martin J. McNamara, who tied vinegar soaked handkerchiefs over their faces, were lowered into the hold by the welders.

They opened the compartment door and after three trips got all seven men to safety, though the latter were all temporarily blinded from the effects of the fumes and were so weak that they could hardly stand. The heroism of the firemen and the resourcefulness of the welders were the subject of considerable comment in the press.

PAINTS AND VARNISHES "DRY" IN TWO VERY DIFFERENT WAYS

According to the Bureau of Standards the process which occurs when a film of paint or varnish dries depends upon the nature of what is known as the "vehicle."

"Water paints," the report says, "such as whitewash and calcimine, and spirit varnishes, such as shellac in alcohol, dry by simple evaporation of the violatile liquid, this being water in the case of whitewash and calcimine, and alcohol in the case of shellac. The drying of oil paints and varnishes, however, is quite different, and, in order to understand this, attention must be drawn to certain peculiarities of the so-called drying oils.

"Suppose four plates of glass are coated, one with a thin film of water, another with gasoline, another with heavy mineral oil, and another with linseed oil, and all four plates are exposed to the air for several days. The water and gasoline will evaporate and leave the plates dry and practically in the condition in which they were before applying the liquid. The plate covered with the heavy mineral oil will be found to be greasy and in practically the same condition as immediately after the oil was applied. The plate covered with linseed oil will also have a coating on it, but this coat will first become "tacky" and finally set to a hard varnish-like film.

"If this experiment is tried with other vegetable oils, it will be found that some of them—olive oil, for example—behave very much like mineral oils; that is, show only a very slight tendency toward the formation of a varnish-like coating. Other oils, such as those of corn and soya bean, will behave in a manner similar to linseed oil; that is, become a more or less tacky mass, with perhaps the final formation of a varnish-like material."

Some oils are known as drying oils; linseed is one of them. The example quoted above, however, shows that the term drying when applied to oils like these is unlike the drying that occurs when a material wet with water is exposed to dry air.

It is not accomplished by the removal of the water by exaporation, but is due to a change in the liquid itself—a change accompanied by the absorption of oxygen from the air. Although dry weather is a help when a drying oil is applied, the action is helped greatly by the presence of substances known as dryers.

AIR BLOWERS CLEAN THE MOTORMAN'S WINDOW

Accumulations of vapor, steam, moisture and frost on the motorman's windows, of cars on the Ft. Dodge, Des Moines & Southern Railroad, as noted in *Electric Traction*, are removed by means of air blowers. The device consists of two air jets, supplied by two 3-8 in. pipes, each equipped with a nozzle having two openings, 1-64 in. in diameter. An ordinary globe valve, conveniently located near the motorman's right hand, controls the air supply which is taken from the main air reservoir. The apparatus is very efficient in keeping the windows clear so that vision will not be obstructed in bad weather or during the times when conditions favor the condensation and deposition of moisture.

Six Inventions Wanted by the Air Service

THE WAR Department, Air Service, Engineering Division, as a result of its experience during the war, has compiled a list of six inventions which are needed by the military aviation units. By request of the Division, the *Scientific American* has published a brief summary of what is wanted under each head. Inventors who are interested in trying to fill these needs may secure more complete information by addressing the Engineering Division, as above, at Dayton, Ohio.

In the first place, a tank is desired that will withstand a salvo of 15 shots fired at a range of 30 yards, the ammunition consisting of an appropriate mixture of 30-calibre service, tracer, incendiary and armor-piercing bullets. This test must go through without fire occurring in the tank, and it must be successful on 10 successive attempts with 10 separate tanks. In addition, it is provided that the tanks must not weigh more than 5⅓ pounds per gallon capacity, and that the fuel must not be stored under reduced pressure.

Another need is for air-bag floats and landing skids. These are to be used by land machines, usually of the light pursuit type, operating over water. The object is to enable such machines to make an effective landing on the water without capsizing, and to remain afloat after doing so. This has ordinarily been accomplished by constructing the landing-gear axle-spacer so as to form a landing skid, and by storing cloth bags in steamlined housings under the fuselage, together with a tank of compressed air with the necessary piping and valves, and sometimes with an air tank within the fuselage, near the tail. But a more satisfactory design, it is felt, than any now on hand should be possible.

Again, the present portable hangars for field service are usually made of canvas, and are unsatisfactory in that they either blow down in high winds, or leak, or hold pools of water in depressions of their surface, or are too small. Any hangar designed to replace these unsatisfactory articles now in use should be capable of housing at least four De Haviland planes, with room enough left for working on all machines at once. They should incorporate the necessary wiring for electric lights and plugs for extension lamps.

Much is also desired with regard to a suitable gasoline supply gage. The gage should be responsive, serviceable, and *accurate to the last half-gallon.* At present the mounting for the gage can well be left on the tank, as it is thought that the mounting on the dashboard would offer too many complications; still, designs based upon this principle would receive attention.

Perhaps the most immediate need of all is the designing of a single generator and battery which will furnish the power required for the radio installation, the heating and lighting outfit, the ignition, and the motor-driven camera; together with whatever may be necessary in the way of transformers and what-not in order to supply these various units with the electrical energy needed in its proportion and kind. This must be engine-driven in some way, so as to do away with the head resistance of the various wind-driven generators now used. It is almost superfluous to point out that this would be expected to lead to reduction in weight. It is desired especially to have such a design for use with the Liberty Twelve and the Hispano-Suiza; but it is explicitly pointed out that those attacking this problem should think not merely of applying their results to existing motors, but also of developing a set of simple general principles to be incorporated in motors of the future.

A mobile independent cranking device is also wanted, to be mounted on an auto truck. This device is to be an electrically driven cranker for planes not equipped with self-starters; it is to be used at the airdome. The general idea which the Service has in mind is a device mounted on a truck that can be backed up to the front end of any plane, and then a flexible arm attached to the propeller. The electric energy is then to be brought into play which will crank the engine and cause it to begin firing. When the engine picks up, the device should automatically be thrown out of connection with the propeller.

Among the data which the Division is prepared to put at the disposal of those who attack this problem is a statement of the previous experiments, so far as known to the Division.

THE TIN PLATE INDUSTRY

Twenty years ago we did not produce a pound of tin plate in this country, but imported over a billion pounds in 1891. Last year our production was over 3,000,000,000 pounds, our exports over half a billion pounds and our imports insignificant. The value of our product was over $200,000,000 and represented more than three-fourths that consumed in the world.

This is largely a Pennsylvania industry, just one of many, but an illustration of what can be done when an industry is protected by adequate import duties.

WAR INDUSTRIES OF THE BALDWIN LOCOMOTIVE WORKS

Record No. 93 sent out this year by the Baldwin Locomotive Works has never been surpassed in the series for the attractiveness of its makeup and the intrinsic value of its contents. This issue has to do entirely with the output of the complete organization for war purposes beginning with Nov., 1914, and besides the host and variety of locomotives shown there are also the baby gun mounts, the military rifles and the masses of shells of various calibre.

Most impressive of all is the condensed summary, here reproduced, of the grand total of accomplishment.

LOCOMOTIVES

Broad-guage steam locomotives	3246
Narrow-guage steam locomotives	1146
Broad-guage gasoline locomotives	20
Narrow-guage gasoline locomotives	1139
Total	5551

SHELLS

(Including those manufactured by the Eddystone Ammunition Corporation and the Eddystone Munitions Company.)

3-inch shrapnel	2,300,000
75 m/m shells	2,351,555
4.7-inch shells	225,399
5-inch shells	150,281
6-inch shells	1,068,157
12-inch shells	112,553
12-inch forgings	9,000
220 m/m shells	213,615
270 m/m shells	134,795
Total number of shells	6,565,355
Cartridge cases	1,863,900
Miscellaneous ammunition items	1,905,213

GUN MOUNTS

14-inch railway mounts	11
Foundations for 14-inch, mounts	20
14-inch railway mounts, improved type	2
7-inch caterpillar mounts	38
Trucks for gun and howitzer mounts	5 sets

The total number of rifles manufactured at the Eddystone rifle plant was approximately 2,200,000.

The aggregate value of the war contracts executed and delivered by The Baldwin Locomotive Works and its associated companies, the Standard Steel Works Company, the Eddystone Ammunition Corporation, and the Eddystone Munitions Company, was approximately $250,000,000.

The product turned out was not for the United States alone but largely also for Great Britain, France and Russia. A suggestion of the magnitude of the war demand is given in a single sentence: "In the attack and defense of Verdun, for example, approximately 60,000,000 shells, representing 3,000,000 tons of steel, were expended in thirty weeks; and the railways moved the greater part of this material to the firing line."

A NEW RIVET FORGE

A rivet heating forge of a new type, the invention of an employe of the Pacific Coast Shipbuilding Company, is described in *Full Speed Ahead,* the paper published at the plant of the company on Suisun Bay, thirty-five miles east of San Francisco. The account says:

An improved oil forge for heating rivets has been devised by J. T. Shepherd, plant plumber. Several of the forges are already at work. One of their most commendable features is the avoidance of backfire. Higher vaporization of the oil is secured through the use of the new invention.

The main features are a valve on the air line and a needle valve on the oil supply, with a mixing chamber. The latter is formed of a 1¼-inch T with a 1¼-inch nipple and a bell reducer reducing to ⅜. Above this is a second mixing chamber, formed of a 1-inch ell, the oil being carried thence through a 1½-inch T with a ⅜-inch nipple, forming an injector. Free oxygen is taken in with the vapor.

There is a ¼-inch vent on the tank, to make filling quicker, the vent forming a suction on the funnel. It is not necessary for the boy to go to the manifold to turn the air off. This is done right at the furnace. Another advantage is that the new forge needs no labor to connect the hose. A male hose connection is used, obviating two couplings.

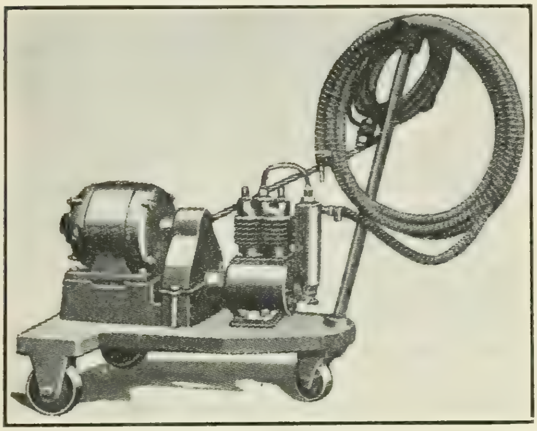
The piping on the end where the valves are controlled is protected with a stay plate, reducing the danger of damage to the forge. The danger of backfire is eliminated by fire clay sealing.

The forges are also equipped with bleed valves, making it possible to clean out the tanks easily. Not only can water be bled from the oil, but the bottom of the tank can be blown clean.

Shepherd, who has been working on the forge design for some time, gave it to the company as a contribution to the yard's productivity.

SMALL PORTABLE AIR COMPRESSOR

The little, handy, electric driven, fully equipped air compressor here shown should appeal to many of our readers who so frequently address inquiries to us for such a machine. Little description seems to be called for. There are two vertical, single acting, air cooled cylinders 1¾ in diameter and 2 in. stroke, the delivery being about 2 cu. ft. of free air per min.



THE MASTER AIR OUTFIT

The rig, which can be connected to any regular electric light socket, is here shown mounted on a little truck, but it is so light that it can be easily lifted around without this. It is known as the "Master" air outfit and is built by the Hartford Machine Screw Company, Hartford, Conn.

THE GAS TROUBLES OF THE DIRIGIBLE

The most serious and perplexing practical problems in connection with the operation of the dirigible have to do with the gas content of the balloon, not merely as to the leakage of the gas outward, which seems to be not entirely preventable, but also as to the inword leakage of the surrounding air and the constitution of the mixture which results. This matter is informingly discussed in a recent issue of *Aviation,* to which we are indebted for the substance of what follows.

Permeability to gases is an inherent property of rubber and it can only be modified, not eliminated, by the method of manufacture of rubber coatings. The best of the modern airship fabrics seldom have a permeability of less than 8 liters per square meter (.236 cu. ft. per square yard) in 24 hours, measured at 25 degrees Cent. (77 degrees Fahr.). Thus it comes about that there is always some diffusion of air into, and of hydrogen out of, a balloon, quite apart from the leakage of hydrogen which takes place through holes in the balloon when the pressure inside is greater than the pressure outside. The relative rates of penetration of rubber by hydrogen and air are not the same but are in the ratio of four to one; that is, when the envelope contains approximately pure hydrogen, one volume of air passes through the fabric into the balloon for each four volumes of hydrogen leaking out. But the "air" passing into the balloon is richer in oxygen than normal air, owing to the fact that rubber is about twice as permeable to oxygen as to nitrogen. The method of determining the purity of balloon gas by measuring its oxygen content and assuming that nitrogen is present in the proportion in which it occurs in air is therefore obviously in error. A better method is to determine the specific gravity of the gas in the envelope, when the error in estimating the purity from the result, without actually finding the relative amounts of oxygen and nitrogen in the gas, is very small on account of the small difference in the densities of these gases. The determination of the oxygen content may be useful, however, from another standpoint, that of the determination of the stage at which the balloon gas becomes an explosive mixture. This stage is reached with a greater percentage of pure hydrogen than would be ordinarily the case, since the oxygen content of the "air" diffusing into the balloon is so high.

A PORTABLE DIVING BELL

Although what we may call the old fashioned diving bell now seldom figures in print, the armored individual diver having deprived it of much of its formerly legitimate employment it still finds employment for special conditions. The *Technist Tidskrift* gives an interesting description of the bell used for the Central Harbor at Gothenburg. The bell as described consists of an upright chamber, 32 ft. 10 in. long by 24 ft. 8 in. wide, suspended from an overhead traveling crane with longitudinal and transverse travel. It is supported from rails resting on piles driven along the quay wall and securely held in position by diagonal struts, as cross ties would have interfered with the working of the bell. It is provided with two air-locks, one for workmen, and the other for materials, the air chamber is 11 ft. 6 in. high, arranged for water ballast tanks on top. To sink the bell, water is pumped in by a 4 in. electrically driven centrifugal pump. The maximum air pressure used is 21.3 lb. per sq. in. above atmosphere equivalent to 50 ft. of water. The quantity of water in the tanks is regulated by the air pressure through a special valve which permits surplus water to overflow and adjusts the total weight of the diving bell to the depth of immersion. Compressed air is supplied by a blowing engine erected on the top of the diving bell and driven by a 6 h. p. electric motor. It is capable of delivering 350 cu. ft. of free air per minute at a pressure of 21.5 lb. per sq. in. The lower edge of the diving bell can be raised 5 ft. above water level in order to be quite clear of the quay wall which is a shell of reinforced concrete with a heavy top and suitable partition walls. It is constructed in sections of 164 ft., which are completed in two weeks, the wooden forms being fixed the first week, and the concrete cast the second week. The whole of the work is executed under compressed air, the diving bell being raised as the work proceeds.

FRESH AIR

The Arizona Anti-Tuberculosis Association, addressing chiefly a local clientele, has some things to say about air conditions which should be applicable and worth heeding everywhere.

A clear distinction should be made, it says, between "cold" air and "pure" air, the one not necessarily employing the other. Many people, in their efforts to prevent tuberculosis, are obsessed with the notion that all cold air is pure air and that all warm air is impure air, and there is danger in the notion because it gives a false assurance of security.

It has been found sometimes by tuberculosis patients that sleeping porches do not always give the expected results. There are instances where sleeping porches are found to be "dead air" pockets. Moreover, the outside air is not necessarily always pure air, although the chances are in its favor. The outside air in the close vicinity of a smelter, for instance, tends to kill vegetation and is harmful to animal life. It would not do for a tuberculosis sufferer to depend on outside air in such a region.

The open window does not necessarily insure a sufficient supply of pure air, although it is, of course, preferable to the closed window. In addition to opening the window, provision should be made to secure some circulation in the room so that the air will not become "dead" air. This is the same as creating a draft and many people will be horrified at the advice, the fear of a draft being deep-rooted.

The ideal way is, of course, to sleep in the open air with sufficient protection to insure the sleeper against cold and rain. The next best way is to have at least two windows open to secure circulation.

Worst of all is the idea that cold air in a closed room is preferable to warm air in a closed room. Cold air in a closed room cannot long remain pure. It becomes laden with carbon dioxide gas from the lungs of the persons living or sleeping in the room. The only difference between a closed room with cold air and a closed room with warm air is that the former is more uncomfortable than the latter. Reasonably cool air is both living rooms and sleeping rooms is highly desirable, but the coolness must come from the outside and must be mixed with purity to be effective; it must not be cool simply because of the absence of heat.

COMPRESSED AIR TO STIR THE PAINT

Our readers should be by this time quite familiar with the use of compressed air for the actual operation of painting. A writer in a recent issue of *Factory* calls attention to another important use of air in large paint ships.

Nearly all large plants, he says, have paint rooms of their own. Here is stored the paint supply of the whole factory. Because of the tendency of the paint to settle, it must be stirred up each time any quantity is withdrawn. As a rule, the stirring of paints by hand is done to the accompaniment of aching muscles and breaking backs. One good-sized factory, however, performs the whole operation by the turn of an air-cock. There happens to be a high-pressure air supply handy to the paint room. Paint is kept in barrels each containing a double wooden paddle. When the paint requires stirring, a pneumatic reaming tool is slipped over the end of the paddle shaft which projects above the barrel top. This shaft is held in place by two crossed pieces placed across the barrel head. By using the shaft in place of a reamer shank, the paddle is whirled rapidly and the paint mixed in a surprisingly short time. After one barrel of paint is mixed thoroughly the reaming tool is slipped over the paddle shaft in the next barrel. Thus the whole job is done quickly and with little labor.

The man who adopts familiar equipment to new and useful ends is many times more valuable to his employer than the one who calls for a special machine for each new job that develops. Compressed air is a valuable and easily adaptable power around a plant.

AN AIR COMPRESSOR AS A WATER HEATER

We are credibly informed of what we must characterize as a case of perverted ingenuity or a reversal of normal function of apparatus in the shops of the San Francisco Fire Department. They have here quite naturally an air compressor supplying compressed air for various uses around the shops, and the air cylinder of this is very properly provided with a water jacket. The water jacket as we all know is normally a cooling device for keeping down the temperature of the air cylinder and also for cooling the air as much as possible while undergoing the operation of compression.

In the case here spoken of the water jacket of the air cylinder is regarded and is treated as a heater of the water rather than a cooler of the cylinder and its air content. A tank for hot water for labatory purposes has been placed near the compressor and at a height of three or four feet above it. This tank is kept full of water, and it is connected by two unobstructed pipes with the water jacket. One of these pipes is connected with the top of the jacket at one end of the air cylinder and the other pipe with the bottom of the jacket at the other end of the cylinder. When the compressor is put in operation and the cylinder begins to get hot the water also is warmed and begins to circulate, rising to the tank through one of the pipes and descending by the other pipe as in any water heating system. As the compressor keeps going the water naturally gets hotter and hotter, but the compressor cylinder and the compressed air do not get cooler and cooler. It should not be necessary to say to anybody that the coldest water available should be supplied in constant free flow to the water jacket.

ALCOHOL HEAVILY HANDICAPPED

The following is not provoked by current prohibition legislation but deals with alcohol as a source of power, and is in fact the opening paragraph of an important editorial in *The Engineer.*

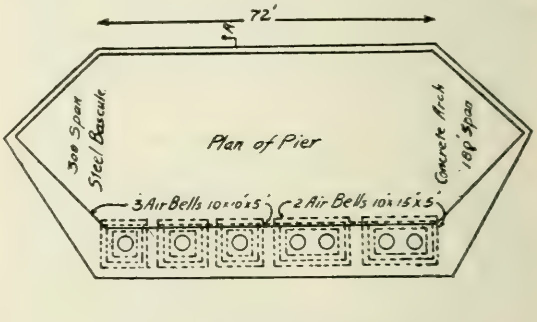
Alcohol, produced by the distillation of vegetable growth, differs from all other liquid fuels in one very important respect. Mineral oil, coal, peat, lignite, and other natural fuels were, as far as we know, all "manufactured" thousands, in some cases millions, of years ago by cosmical forces. They cannot be renewed by the will and action of man. Alcohol, on the other hand, is derived from a source which must remain inexhaustible as long as the earth sustains plant life, for it may be derived in greater or lesser quantities from practically all vegetable matter. For this reason it makes a claim to the highest consideration.

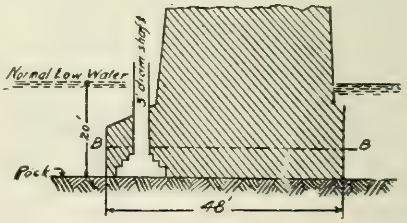
But it suffers from two serious drawbacks. In the first place, unlike coal or wood, or raw oil, it does not exist as a ready-made fuel; it has to be manufactured by the art of man. In the second place, it has the unfortunate quality that it leads to intoxication. How much it has suffered from the second defect it is impossible to estimate, but, possessing as it unquestionably does the highest merits as a liquid fuel, we can scarcely doubt that, had it not been gifted with this unfortunate quality, had it not been the basis of all the potable liquors which fall under the control of the Board of Customs and Excise, it would long ago have won a position in the industrial world, from which it has been debarred partly by the natural failings of weak humanity, partly by the overzeal of temperance advocates, and partly by the advantage that accrues to the State from its taxation. If only alcohol were as inconceivable as a beverage as Russian oil, it would have enjoyed that position in the world of industry to which by its merits it is entitled.

COMPRESSED AIR FINISHES A TREMIED FOUNDATION

A novel and ingenious method of securing a satisfactory foundation under difficult conditions as employed by the Navy Construction Company in building one of the bascule piers for the Market Street bridge over the Tennessee River, at Chattanooga, is described in *Engineering World* September 15.

The pier supports a 180-ft. concrete arch span on one side and a 300-ft. steel Scherzer rolling lift span on the other. It has a foundation about 48 ft. wide and 72 long, exclusive of the triangular noses. It is founded on limestone rock about 20 ft. below normal low water. The roadway is about 70 ft. above this water level, making the pier about 90 ft. high. The limestone rock is overlaid with about 5 ft. of gravel. A steel cofferdam of United States steel piling was first driven and the excavating was done under water with a ¼-yd. Lakewood clamshell bucket.





Section AA

It was found impossible to pump the cofferdam dry although it was divided in halves by steel piling. This was on account of the huge fissures in the rock through which the water boiled in such volume that made pumping it dry impossible. Divers with a sand pump cleaned up the bottom. Five air bells, as shown in the sketch, were made of 2-in. planks with a 3-ft. diameter steel shaft bolted on top of them. These bells were sunk on the channel side of the pier, after which about 6 ft. of concrete was tremied* over the entire foundation. After the concrete was set up the cofferdam was pumped out and the remainder of the pier built in the dry.

An air lock was placed on the bell shafts, one at a time, and the large crevices in the rock under the bells were cleaned out, the timbers torn out of the bells and the bells concreted up under air pressure. The shafts were then cut off above the top of the foundation.

The huge crevices in the rock were filled with soft yellow clay and it was impossible to clean them out with the divers and sand pump. In order, therefore, to be sure of a good bearing for the pier on the bascule channel side, where the highest pressure is, the air bell method was devised, adopted and proved to be satisfactory.

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*A tremie is defined as "an apparatus for depositing and consolidating concrete under water, essentially a tube of wood or sheet metal with a hopper-like top. It is usually handled by a crane." In the vertical section in the cut the concrete below line B B was tremied.

THE BUSY PAINT GUN

An issue of the *Scientific American* last summer bore upon its front cover an attractive picture in colors showing the interior of an automobile factory with a workman painting a wheel with the aid of compressed air. The use of the paint gun, as it is now coming to be familiarly called, is no longer a novelty but it is still interesting, and the account given of its extensive employment, in connection with the suggestive illustration referred to will be found well worth reading.

The modern method of applying various kinds of points and other protective coatings by the use of compressed air is rapidly superseding the old hand-brushing method, not only by reason of the great saving in time and labor, but also due to the fact that better results are obtained.

There is hardly a comparison between pneumatic painting and the old-style way. One handy workman, for instance, can do the work of three to twelve or more skilled painters using hand brushes, depending upon the nature of the work. Uniformly finished coatings free from streaks and brush marks are produced. Rough, irregular surfaces and those inaccessible or difficult to reach with a brush are readily coated. Where single coat work is required, either a lighter or heavier coating can be obtained than is possible with hand brushes. The gun, for such is the usual name of the pneumatic painting device, may be quickly mounted on an extension pole attachment for painting surfaces beyond the reach of the operator. The air-tight material container prevents the formation of paint skins, and makes it impossible to combine dirt with the paint. These are but a few of the leading advantages of the pneumatic system of painting.

Penumatic painting equipment consists of a container; a flexible, metal-lined hose; a heavy rubber air hose; and the paint gun or nozzle member. Some materials require continuous agitation in order to keep the heavier parts in suspension, and for this purpose an agitating attachment is employed. This device is screwed into the main air port in the bottom of the control head. The agitating is done by air, which, after passing through this attachment and bubbling up through the paint, is allowed to escape through the bleeder valve in the control head. When using certain varnishes and enamels, on the other hand, it has been found that, in order to obtain the best results, the air should be heated before it reaches the gun. If this is done and the material is also heated before being placed in the material container, a perfectly smooth coating can be obtained. For this purpose an electric heating attachment is sometimes used with a pneumatic painting equipment. This attachment may be operated from any ordinary electric light socket. It is so designed that it may be turned on at the same time as the gun trigger is pulled by the natural grip of the hand.

Compressed air for the paint gun is generally supplied by a compressor unit which may serve several paint guns at one time.

Today paint guns are employed to a very wide extent. In many industrial establishments they are employed for all kinds of painting. In the production of explosive shells during our participation in the world war, the old inefficient method of applying protective coatings by dipping, pouring, and swabbing, was dropped in favor of pneumatic painting.

It is announced that plans are being made at Chicago by the "Our Country First Conference" which was formed in that city this autumn under the auspices of the Illinois Manufacturers' Association, to organize all business, farming and commercial associations in the United States into one body to deal with social unrest and "the preservation of individual and property rights."

COAXING WINDMILLS IN DENMARK

During the coal famine caused by the war many attempts were made especially in Denmark to improve the working of the windmills geared to dynamos to generate electricity. About 250 installations on farms and small estates have proved fairly satisfactory. Many experiments in this connection were carried out by the late Mr. P. la Cour, and a trial mill designed by him is still being used for observation purposes. During about one-third of the year there was either complete absence or excess of wind, and the force available was very variable. It was nevertheless found possible to save fuel for steam or gas-driven power producers. The cost per kilowatt from peat gas fired plants is approximately the same as from a windmill-driven installation. Attempts were made to design special three-phase dynamos capable of maintaining constant voltage independent of the speed of the mill, special attention being also paid to automatic adjustment of the sails in order to reduce the cost of attendance.

COMPRESSED AIR LOADS AND UNLOADS COAL CARS

The accompanying half tones illustrate a special employment of compressed air at the plant of the King Coal Company, Oakland, California. The air is here used for both opening and closing the doors on the drop bottom cars and also for opening the gate of the hopper from which the cars are loaded. By this arrangement one man operates the entire train of three cars, receiving the coal into the cars, running them along the track and then dumping the load.

Fig. 1 shows the operator and his various levers, Fig. 2 shows the hopper from which the cars are loaded and in Fig. 3 the cars are seen upon the dumping trestle.

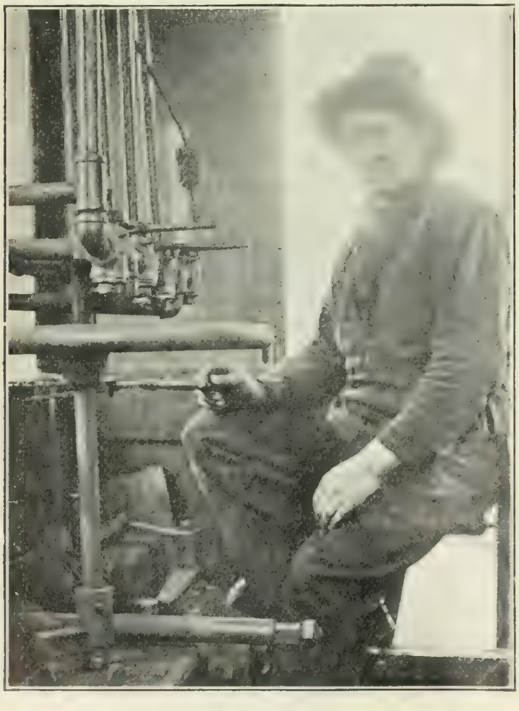


FIG. 1—THE OPERATOR AND HIS LEVERS.

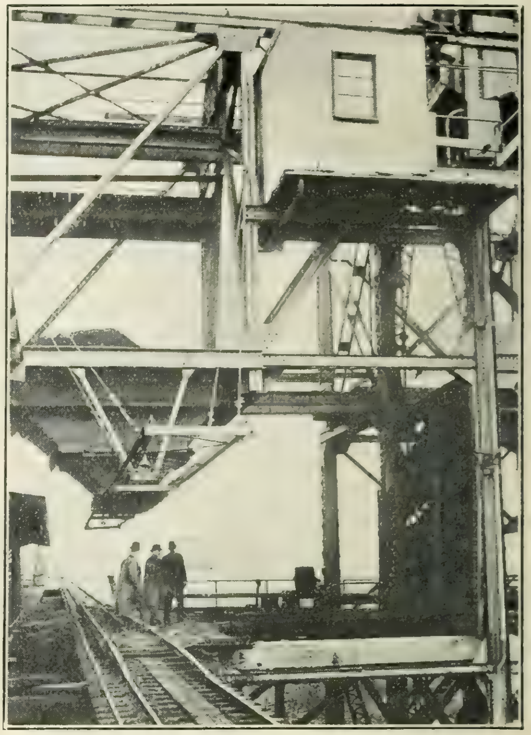


FIG. 2—HOPPER FOR LOADING CARS.

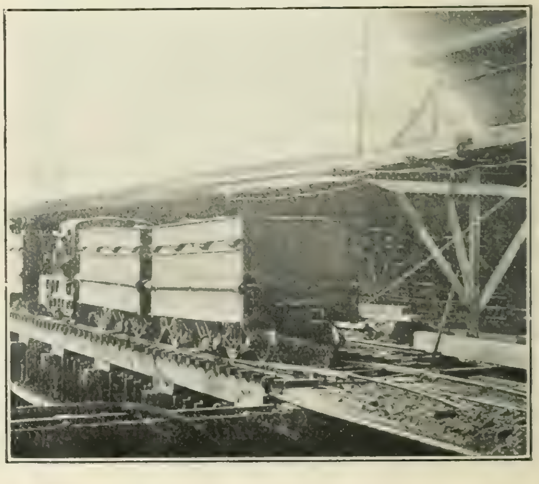
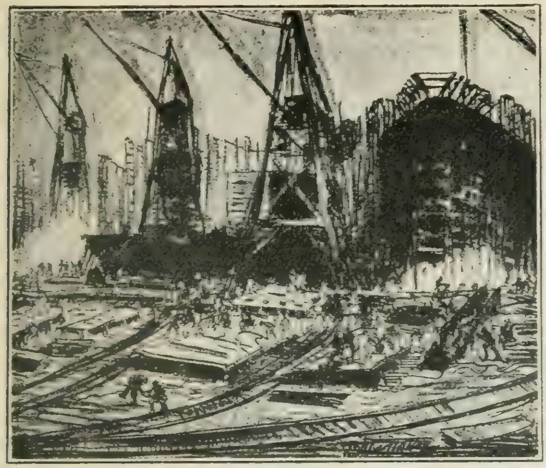


FIG. 3—CARS ON DUMPING TRESTLE.

THE SHIPBUILDERS*



Incessant, harsh, staccato, up from the shipyard rises the roar of the hammers.
From its weird, runic undertones, strange voices come to the poet:
Long soft sighs of the Norther through the pines on Oregon hillsides;
Murmur of mountain streams; wild crashings of mighty waters
Harnessed by pygmy men to force his designs upon nature.
Come with me through the shipyard and see through the eyes of the artist
How man applies this power to force his designs upon nature.

The Steel Shipyard

Here man is dragging great bars of steel white hot from the furnace.

Smash! Press! Shear! He will shape them anew to his purpose.
Drill! Punch! Scarph! Bolt, plate and angle and zee bar
On white hot rivets roar the hammers, and ere night
Black against the twilight sky looms the forward bulkhead.

The Wood Shipyard

Mighty timbers of pine, sawn from the Lord of the Forest
Man will attack with saws and dubber and planer and hammer,
Driving home bolt and treenail until, as if by magic,
Framed and planked and caulked, a ship stands ready for launching.

* * * *

Thus the brush and the pen sense the rough, fierce power of the worker
Who at his country's call threw steel and wood into ship shapes—
Mighty the will of man, all subduing, all comprehending.

TRUE VISION

Agitators and their dupes, those who block the wheels of a nation's progress, those who hinder the solution of pressing problems, those who wreak havoc in the lives of millions for fancied self-interest, are commended to a careful perusal of Frederick Moxon's "True Vision," which we take great pleasure in reprinting from our excellent neighbor, *Power*:

The nation's business—yours and mine—
By what authentic, certain sign
Shall it be given us to see
The growth of true prosperity?

By whirr of spindle, hum of wheel?
By stroke of hammer, clang of steel?
By busy docks, car-crowded rails?
By daily food that never fails?

"Not so," replies the dreamy drone,
Who knows no vision save his own
False paradise of workless days,
With "Business" a discarded phrase.

But for the patriot brain and heart
That bravely seek their place and part
In building up the nation's power,
Shines triumph in the present hour.

Theirs is a vision deep and wide,
The stimulus of worthy pride;
For in true work true men employ
Life's gift of service, linked with joy.

Advertisements are meant to "pull." In the course of the war an office manager, according to the *Nation's Business,* tried to put pulling power into his advertised desire for a messenger. The advertisement he printed read: "Boy wanted—Young or Old—Either Sex."

The illustrations are from lithographs drawn on stone by Carl Walters of Portland, Oregon, and are reproduced from the Pacific Marine Review by courtesy of the G. W. Standifer Construction Corporation.

Notes of Industry

Boulders encountered in excavating the Cape Cod Canal, some up to 80 tons, were removed by blasting. The blasting was usually done by placing charges of dynamite on top of the boulder, depending on the overlying water to serve as tamping. The explosive used was 75 per cent. gelatine dynamite in charges from 25 to 200 lb. The best results seemed to be produced by charges of about 50 lb., even if they had to be repeated.

The power required to drive a flat transverse surface through the air is, in horse power per square foot, approximately 6 millionths of the cube of the velocity in miles per hour, or say, v^3,000,006. Every square foot of transverse surface therefore, in an automobile or airplane, requires, to overcome the air resistance alone, about ½ h.p. at 43 m.p.h., 1 h.p. at 55 m.p.h., 2 h.p. at 70 m.p.h., and 3 h.p. at 80 m.p.h.

The airplane record with passenger from Turin to Rome was broken this year by Lieut. Brack-Papa, flying a Fiat B R. biplane equipped with a Fiat 700 horse-power twelve-cylinder engine. The distance of 362 miles was covered in of 161 miles an hour. The previous record with passenger over the same route was 2 hr. 50 min., and was established by Sergeant Stoppani on a Sia machine.

It became public at the recent annual Convention of the American Federation of Labor that its membership at present is 3,250,068. There is a cash balance in its Treasury of $192,490, the receipts for the year being $654,687 and the expenditures $587,518.

Albert Brunt, who for the last four years has been engineer in charge of the direct-current machine design section of the industrial engineering department of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, has resigned to return to Holland, his native country. Mr. Brunt was born in Woerden, Netherlands, Nov. 6, 1883, and received a complete education in the schools and universities of that country. His technical training was received at the University of Delft, where he took the degree of mechanical engineer in 1905 and electrical engineer in 1906. For two years following this, he was employed in design work with electrical manufacturing companies on the continent. In April, 1909, he came to America and entered the Westinghouse employ. Mr. Brunt was an active member of the A. I. E. E. and has prepared several interesting articles for technical papers on direct-current motors.

"Two popular methods of getting killed," is the title of the latest safety-first pamphlet issued by the Pere Marquete and other Michigan roads. The two methods are the highway crossing method, and walking along railroad tracks. Interesting comparisons are drawn between these American methods and ancient method for the same purpose. The ancients are believed to have had the better ways.

A report of the Mechanics and Metals National Bank of New York says that, on the extreme quotations for the month of June, it cost the Englishman $1.14 to buy $1.00 worth of American goods; the Frenchman, $1.42; the Italian, $1.67; the German, if he were buying, $4.00. On the other hand, the American could buy a dollar's worth of goods for only 88c in England; 70c in France; 60c in Italy, and 25c in Germany.

In a recent U. S. patent for non-inflammable celluloid the claim reads: "the method of subjecting low-inflammable celluloid material to a pressure of not less than about 300 kilograms per square centimeter." This would be more than 4,000 pounds per square inch. How the high pressure could affect the inflammability is not apparent.

In view of the increasing use of oil instead of coal for power development, it will be noted with interest that in the enormous shipbuilding plant of Harlan & Wolff, at Belfast, Ireland, oil has thus supplanted coal. It will be remembered that this firm also uses compressed air very extensively, having more large hammers now driven by air which normally would be steam driven than any other concern in the world.

That the airplane engine is not above ordinary humdrum work is shown by the fact that one has recently been installed in a London factory as a stand-by power unit. It burns gas instead of petrol and the cooling water is circulated through a common cast iron radiator. It is an eight-cylinder engine, surplus from the war, and at the aerial rate of living would develop 200 horse-power, but has been rated at 75 horse-power on earth to give it a reasonable length of life.

A Self Contained and Unusually Portable Air Compressor

By H. L. HICKS

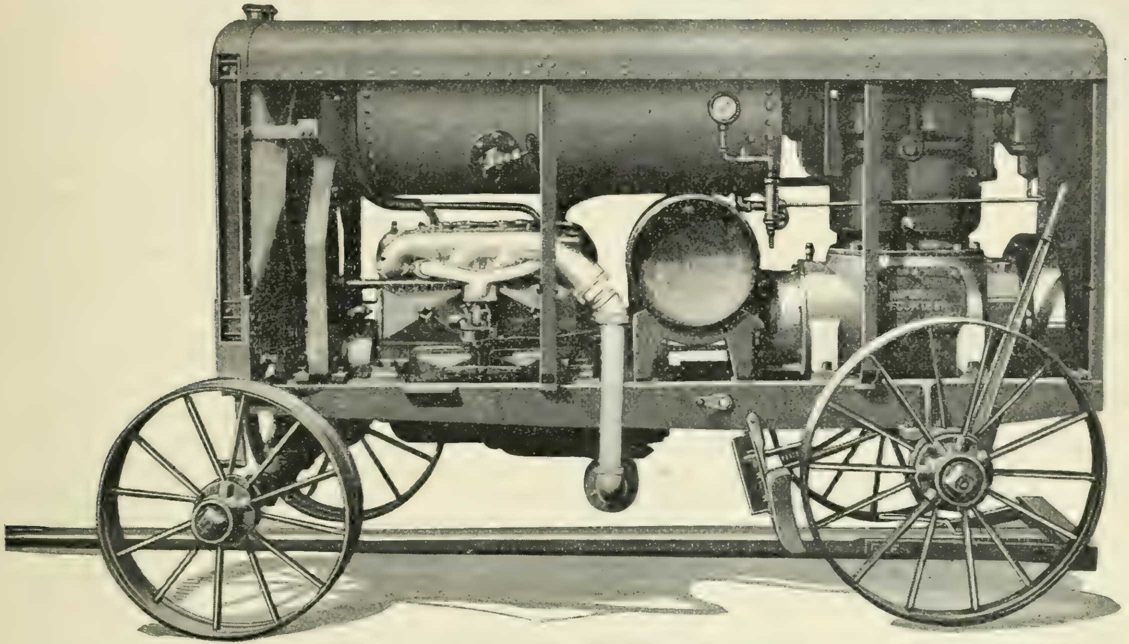


FIG. 1—THE LARGER OUTFIT COMPLETE

THE ONLY thing that for years has kept the contractor from equipping his men with the various pneumatic labor saving devices has been the trouble and expense of installing air power plants for short-time jobs. Despite the advantages incident upon the use of air operated tools, he has found it difficult to justify the costly transport of a cumbersome stationary machine, the building of a shelter, the setting up of a steam boiler, perhaps, and the laying of a pipe line for only temporary use. Then, too, he had to count on tearing down the plant when the job was complete.

The coming of the portable type of air compressor was a great boon, though quite often, "portable" was somewhat of a misnomer, and meant merely "mounted on wheels." Portable air power equipment, however, did away with the expensiveness of compressed air on temporary jobs and soon became an indispensable part of the contractor's equipment. Portable outfits of many varieties have been developed in the few years just past, each successive design bettering the one which preceded it, and now there appears a new type.

The Ingersoll-Rand Company* has recently introduced a light weight gasoline-engine-driven unit, built in two sizes, to be known as the Imperial Type 14 Portable Compressor.

These portable compressors are all-steel outfits, from their sheet steel canopies to the broad tired steel wheels. The power plant of each consists of a duplex, vertical compressor, driven, at high speed, by a four cylinder, four cycle, tractor type gasoline motor. It is pointed out that the outfit, being designed especially for portable use, has had unnecessary weight eliminated, and affords maximum air power output per unit weight. The larger machine, Fig. 1, of 210 cu. ft. capacity, weighs only 6000 lbs. and the 118 cu. ft. unit 4000 lbs. A point is also made of the fact that gasoline motor drive provides power in economical form and in a mechanism that can be confidently entrusted to the average operator, for men familiar with gasoline engines are everywhere available and make thoroughly competent engineers.

The compressors have cylinders, single-acting, cast en-bloc, with cylinder heads, valve chambers and water jackets integral. Both intake and discharge valves are of plate type and are located directly above the cylinder bore. Crank shafts and connecting rods are drop forgings. Air pistons are fitted with three-piece piston rings and, in addition, with an oil wiper ring. This latter returns all surplus oil from the cylinder wall to the crank case, and is claimed to obviate the

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*11 Broadway, New York.

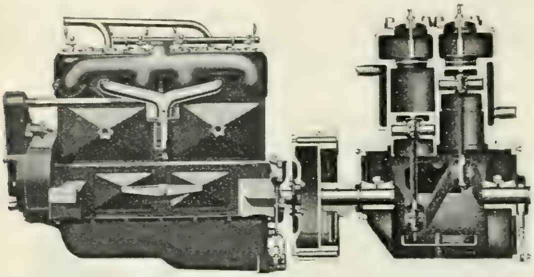

FIG. 2—POWER PLANT SECTION OF THE SMALLER MACHINE

difficulty caused by having the air carry an excess of oil into the receiver.

All bearings are die castings of anti-friction metal. Hand holes in the crank case permit convenient access for adjusting main bearings and those of the crank pins. All parts are lubricated by splash from an oil reservoir in the crank case.

The compressors are provided with inlet unloading devices which automatically close the compressor intake when the receiver pressure rises above a predetermined limit, and permit the machine to again take up its load when the pressure has fallen a definite amount.

The gasoline driving motors are of long stroke type, and operate at medium speed. They are equipped with high tension magneto ignition, with automatic governors to maintain constant speed under all working conditions and to prevent overspeeding when idling. A splash oiling system lubricates all moving parts. Starting crank is located at the front of the machine beneath the radiator.

Both compressor and driving motor are water cooled by a circulating system, with centrifugal pump, large radiator and powerful blast fan. The manufacturer directs attention to the fact that the radiators are made up of removable sections, a construction which allows the removal and repair of a damaged section without taking down the entire radiator or interrupting the use of the compressor.

Each of these units is equipped complete with receiver, safety valve, drain valves, pressure gauge and service valves to which the air hose lines may be attached. When the fuel tank has been filled, lubricating oil provided and the cooling system supplied with water, the units are ready for work.

The mounting of the machines is worthy of note, particularly the swiveled front axle which moves freely in both horizontal and vertical planes. This, with the rigidly attached rear axle, gives three-point suspension, and permits the outfit to pass over inequalities of the ground without any racking effect or misalignment of the power plant.

The two sizes differ in respect to the location of the air receiver and in minor details of design. These differences are, in general, to be seen from an inspection of the accompanying illustrations. Fig. 2 is a section of the engine and compressor of the smaller outfit.

COMPRESSED AIR IN THE OIL REFINERY

The air compressor is a very useful and necessary unit in the modern oil refinery and the variety of the employments for the air is worth noting. Some of these uses of the air mentioned in the following summary by the superintendent of one of the biggest refineries in Tulsa, Oklahoma.

Air is compressed in six compressors to a pressure between 110 and 125 pounds for the operation of riveting hammers and air motors for drilling and reaming in the machine and boiler shops. Air at this pressure also is used for blowing out oil lines, after pumping the products through them, to clean the lines; also for pumping wax distillate or refined wax so as not to permit the product to remain in the lines.

Three more air compressors, handling approximately 3,000 cu. ft. of free air per minute, with a maximum pressure of 50 pounds, are used for agitating batches of both refined oil and lubricating oil, as well as wax distillate in treating. Low pressure air also is used for blasting the filters, that is, for breaking up the settled mass of Fuller's earth after it has been used for filtering.

Three more large compressors handle approximately 3,500,000 cu. ft. of gas which is compressed up to 250 pounds per square inch for the extraction of gasoline. Compressed air also is used in the plant for transporting sulphuric acid, for the testing of stills, tanks and railroad air brake equipment, and for agitating foam fire-fighting solutions.

Most of these compressors are now steam-driven units, there being two electrically driven compressors in the plant; but where conditions are favorable and electric motor drive is possible, in future installations motor drive will be used.

John Ericson, Chicago, has resigned his position of city engineer to accept the post of consulting engineer for the Board of Local Improvements. P. S. Combs was appointed his successor and will be assisted in the work by V. S. Patterson, assistant engineer.

LeGrand Brown, formerly an engineer in Rochester, N. Y., who has been engaged in consulting work in California for a number of years, has been appointed deputy city engineer of Rochester.

GASSING THE GROUND SQUIRRELS

On the line and in the neighborhood of the Pacific Electric Railway ground squirrels have been proving a costly pest. They breed in vast numbers and they burrow into the banks of the cuts, the abutments of bridges and elsewhere and they also do great damage to the crops of the farmers. Poison and other devices have been tried for their extermination but with little satisfaction or any assurance of permanent relief. The company spoken of has, however, now found a means of keeping down the nuisance. This is by the use of asphyxiating gases in the burrows.

There is in the market an automatic distillate vapor machine which does the business, killing not only the squirrels but also other predatory animals, such as rabbits, badgers, snakes, owls, etc. Regular engine distillate is used in the machine which produces a white vapor. The gas when generated is forced into the burrows, effort being made to have the wind in the operator's favor so that the gas may reach as deeply as possible. Other details of the operations involved as developed in practice it is not necessary to particularize here.

Upon entering a cut to gas, one foreman and four assistants work together. Two men with a gas machine work on one side of the cut, while two more with a second machine take the opposite side. The best time to gas is after a rain, when the holes have been opened up by the water. One foreman and four men will average eighty main burrows in a ten hour day, the two machines consuming three gallons of distillate in the period.

DANISH FLEET TO CARRY COAL FROM U. S. TO DENMARK

As a result of a statement made public in these columns last month and elsewhere, by the Shipping Board's Division of Operations, and in which it was shown that Europe, despite its dire need for coal, was diverting its own tonnage to the more profitable trade routes, leaving to America the job of carrying the less profitable coal cargoes to Europe, the Danish Legation subsequently announced that sixteen steamships, aggregating 61,000 tons were to be immediately placed in the coal trade and will carry coal from this country to Denmark.

This prompt response of Denmark has been very gratifying to the Shipping Board as the assignment of this large fleet will greatly aid the Board in caring for European fuel needs. Word also was received by the Shipping Board that Sweden was taking cognizance of the situation and was preparing to place its vessels in the American to Sweden coal trade.

The Shipping Board has been further advised by the Italian High Commission to this country that the Italian vessels previously announced by the Shipping Board as carrying coal from the United States to Gibraltar were in reality carrying coal from the United States to Italy, being diverted from Gibraltar to various Italian ports. This news further emphasizes the statement made in the announcement of the Shipping Board that the Italians were putting forth every effort to assist themselves in this coal crisis.

LIQUID OXYGEN

In a lecture by Sir J. Dewar at the Royal Institution, London, it was stated that the total output of the twelve factories producing liquid oxygen in England was 1,000,000 cubic feet, say 118 tons, per day, of which 85 per cent was used for cutting and welding metals and 15 per cent for medical purposes. In Germany one plant alone was producing 100 tons per day.

Liquid oxygen has been much used by airmen flying at high altitudes. For this purpose it is stored in vacuum vessels provided with a mechanism for controlling the evaporation, and with tubes leading to a mouthpiece through which the aviator may inhale. There are three types of mechanism. In the first, the liquid is heated electrically; in the second, the evaporation is promoted and controlled by thermal conduction through a rod of copper or aluminum in the liquefied gas; in the third the liquid is siphoned out into an evaporating chamber, from which the gas is conducted through tubes—to bring it to air-temperature—to the airman's mouth, the rate of evaporation being controlled by adjusting the conical stopcock through which the gas is passed.

Liquid air is stored in spherical metallic vacuum vessels holding from 5 to 30 gallons, the high vacuum required being maintained by keeping absorbent charcoal, cooled to the temperature of the liquefied gas, in a chamber attached to the lowest part of the external wall of the inner vessel, whereby the annular space is highly exhausted. These vessels are durable, and the rate of loss from the largest does not exceed 5 per cent per day.

HOLIDAY GREETINGS

Compressed Air Magazine desires to wish for its subscribers throughout the world a Merry Christmas and a Happy New Year. Our solemn hope is that "Peace on Earth and Good Will Toward Men" may soon prevail industrially and politically in all lands.

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W. L. SAUNDERS, *Editor*
FRANK RICHARDS, *Technical Editor* FRANCIS JUDSON TIETSORT, *Managing Editor.*
CHARLES A. HIRSCHBERG, *Business Manager.*

Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

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GETTING DOWN TO BRASS TACKS WITH RADICALISM

WRITERS for the magazines, newspapers, and the trade periodical press, which latter should now be in a position to know better, have in the last six months printed countless articles and editorials respecting the causes of industrial unrest. In nine cases out of ten they have been wrong fundamentally, although expressing statements of lesser contributing causes.

The answer to the query, "What is the cause of industrial unrest in America when the people as a whole are enjoying a flood tide of prosperity?" lies in the records of the Department of Justice and in the Department of State at Washington. The subject is one on which we must speedily get down to brass tacks!

We are having revolutionary labor troubles beyond even the power of the more sober-minded labor leaders to control because we have been temporizing with and mollycoddling criminal foreign agitators seeking the "one great union," and universal revolution.

We have permitted class legislation for the selfish benefit of a class in this country and have encouraged thereby the idea promulgated openly and freely on street corners and in some 500 unsuppressed publications, that property rights and government by the people should be destroyed and all industry taken over by the gentle I. W. W. and other radical organizations.

Thus far, some 110,000,000 people in this country have been gazing at each other and asking the question, "What are you going to do about it?" and doing nothing. We have got to get past the stage where we saunter up to the edge of a crowd listening to a soap-boxer demanding that organized society be tumbled about our ears and that chaos be given free rein, and then slipping off without doing or saying something equally forceful.

This means that we must, by orderly processes of law, place moral and mental incendiaries beyond the power of wreaking their wild will upon the established institutions of the Grand Republic, the most successful and thriving example of free government in the history of nations, with the possible exception of that paradoxical "tight little isle' overseas from which sprang our potent political beginnings. We stand for and by the law. We are capable of upholding our place as a government and as a people through its workings, for if we lack laws to govern a given situation we can certainly enact efficacious laws and penalties that will govern them.

We are a good-natured people, slow to mighty wrath, but when aroused we are capable of decisive action, as was noted in a general way in the late war, we believe. In the words of Senator Thomas of Colorado, "American citizens should awaken to the situation that confronts them. When this awakening comes, God help those who would send to destruction the great and mighty institutions of this country."

America will never permit "communism" or even an approach to it, but it will not do for the sane people of this land to sit by and ignore its mad dog proponents.

The I. W. W. has been largely responsible for the hundreds of strikes sweeping the country, actions by minorities of deluded men and women under the spell of skilled European propagandists sent here for purposes not unknown to our government. They want a single great union, which they contend would automatically start a revolution, with resultant seizure of all power and the running of the country for the benefit of the foreign group sent here for just that purpose.

Our appointed leaders and executives in government, industry and in all social life have the greatest, the most compelling duty of the times facing them, and the permitting of open plotting, of incendiary and destructive "free speech" and publication, is not a part of that duty.

We shall have to face a greater war and upheaval than that which shook Europe and the whole world to its foundations, unless we suppress, for all time in this republic, the possibility of class domination by methods similar to those employed by Germany when she surprised and shocked a world.

Richard H. Edmonds, editor of the *Manufacturers Record,* Baltimore, telegraphed to E. H. Gary, Chairman of the Board, U. S. Steel Corporation, declaring that arbitration with the Bolshevik "revolutionist" in this country would endanger our government and civilization itself. He made the statement that the night Trotzky left this country he called upon his followers in New York to remain here to "overthrow this dirty, rotten American Government," when the time came. Trotzky has many followers in America. Many of the leading spirits in the strikes throughout the country have been allied in principle and in fact with Trotzky. Radicalism run rampant now seeks to rule over the wreck of the American Government and the Constitution. The point is: Are the American people going to arbitrate *anything* with criminal foreign agitators and their ignorant dupes who are seeking to rend and destroy us?

FACTORIES SPRINGING UP IN FOREIGN COUNTRIES

ONE of the most disquieting effects of the high prices of American manufactured goods and the difficulty experienced by overseas merchants in obtaining deliveries is the stimulus given to the industrial development of countries which, but for the war, would have found it quite impossible to compete with the highly organized industries of the United States and Europe.

High prices, high freight rates, and lack of transport are likely to prove more potent aids to the establishment of manufacturing enterprises in the newer countries than a protective tariff with duties of 100% on imported goods. The difficulties of obtaining machinery and skilled labor, although great, are not insuperable.

In the opinion of the National Foreign Trade Council, a continuance of the present state of affairs will inevitably lead to the growth of manufacturing in many countries which have hitherto afforded large markets for our products, and this may involve serious changes in our export trade. In this connection, it is interesting to note that during the war many industries quite new to India arose to fill the void left by the stoppage of exports from Britain, and that many types of machinery and mechanical fittings are now being successfully manufactured there.

The Bengalee is a capable artisan when properly trained, and it is hardly necessary to add that his labor is not of the highly-paid variety. The development of a prosperous iron and steel industry in the Transvaal—where coal and iron ore in inexhaustible quantities exist in juxtaposition

—is already becoming practicable. In Australia, too, the manufacture of woolen goods is attracting increasing attention.

While such industrial development is bound to come to all countries possessed of the necessary raw materials, it is unfortunate that these markets should in any way be closed to American products at a time when a wide demand for manufactured goods is needed to ensure full employment to American industry. It would seem the part of wisdom to prevent further developments of this kind, whenever possible, by setting aside a definite percentage of factory output to supply to those countries in which manufacturing is not highly developed, the goods which they cannot do without.

THE FIRE OF INSPIRATION THAT HERALDS SUCCESS

A GREAT career of achievement has been known to develop from a moment of strong emotion which fired the spark of ambition to the point of accomplishment and which loosed the energy derived of true inspiration. The most highly accomplished artisan, or the genius we call an "artist" is one who not only originally felt a call for his vocation, no matter what his line of endeavor may be, but who worked tirelessly to perfect himself and in whose responsive soul fire was finally struck.

We call to mind a case in point that may possibly serve as an encouragement to the engineer wrestling with a problem, to the struggling inventor, to the mechanic invested with puzzling obstacles, to the executive pressed for solutions that seem remote, if not impossible. The story to which we refer is no whit less applicable in its lesson to men of practical affairs because the subject character chanced to have been a musician.

A young lady of Chicago who was a student of the violin in the Conservatory of Music at Berlin in 1906, had as a friend a woman singer also studying at the time under a private professor. The singer advised the violinist, naturally a most accomplished musician, but inclined to shirk her practice, that harder work would be required of her if she was ever to become a great violinist. One day the singer, who tells the story, insisted on accompanying the violinist to the studio of the latter's professor, so that she might hear the young Chicagoan's lesson.

The professor suddenly stopped the playing of his pupil and began to storm in the temperamental way of many great musicians, and he himself, it chanced, was a truly great musician whose name has been blazoned over the world.

"It is a pity," he exclaimed. "My dear Miss ———, you are highly talented with the violin but you are lacking in something. You play coldly, as though detached from your instrument. Your mind is not ardently on your work and furthermore you show a lack of intense practice and detailed study. You will never succeed unless there is a change. You will excuse me for being so frank, but the time has come when I cannot refrain from speaking plainly."

The young woman from Chicago showed signs of indignation through the tears that came to her eyes. No one had ever talked to her in exactly that fashion before, although her friend, the singer, had conveyed the same idea in less direct language. The professor relented to the extent of relating for her comfort his own experience.

"My own *maestro* finally turned me out," said the professor, "as what he called his finished product. He told me I was a genius and that he could do no more for me. 'You have wonderful technique,' he declared. 'Your style is superb. You have finish. In fact, you are a genius, but you are *not an artist*. You lack something.'

"I asked the *maestro* what it was I lacked, and he replied: 'It would do you no good for me to tell you. You must find it for yourself.' I was then preparing for my debut concert, and the words of the professor made a deep impression upon me. I worried greatly over the matter. Everywhere, in libraries, in concert and music halls I searched for the element I lacked. I worked for six months, as I never had worked before, in preparation for my debut, but I was afraid in my heart that I should not make the success for which I craved.

"I went back to my *maestro* and begged him to tell me what it was I lacked. He was adamant. 'My dear boy,' said he, 'you must find it for yourself. You have developed to the point of greatest technical excellence, but the artist is still absent. Go and seek—you may find yet what you lack.'

"So, nearly distracted, I set forth again upon my final preparations for my first concert. One evening I was passing through a street near my lodgings and I saw a crowd collected. I pushed my way through and saw a little girl of twelve, bare of leg and foot, standing on a box. She was playing a violin made of a cigar box and she was drawing from it wonderful tones. I was thunderstruck for the moment and could scarcely think clearly.

" 'Here at last,' I said to myself, 'I have found in a little girl what I myself seek.' I pressed close to the girl and asked who she was and her story. She lived in an alley nearby. Her father, who had been a violinist, had died, and she was playing on the streets to earn money for her invalid mother and her little brother.

"Breathlessly I told her who I was. I would make her my *protege.* I would teach her—make her an *artiste.* I bade her come to my studio daily. At last my chance had come! I gave myself to the task. The delighted child rapidly responded to my efforts. I adopted her almost as my own child. She became very dear to me.

"Finally came the night of my debut. I was hopeful, but nervous. I had just gotten dressed in my evening attire and was giving the final touches before the mirror, when a telegram came to my door. I opened it, thinking first it was a word of encouragement from some friend. Instead, it had a message from the poor mother of my little pupil, telling me that she had been run over by a vehicle, that she was in a dying condition in a hospital, and was asking to see me. Would I please hurry to her.

"Agitated, I seized my violin case and raced off to the hospital. One look showed me my little friend was dying. Weeping, I kissed her good bye while she clung to my hand and told me with her last whispers that I must now hurry to my concert, which she was on her way to hear when struck down in the street, and that I should make a great success.

"We, the grief-stricken mother and myself, pulled the white sheet up over the delicate hands and drawn face of her little form. Time was short before my concert and I hastened away.

"Straight to the platform I went. I saw nothing, saw no soul in the audience, was oblivious to all but that which was in my soul. I played that night as I never before had played in my life. Every note was a prayer in my heart. Finally it was over. The audience was in a tumult. Flowers were hurled at my feet. I picked up a bunch of violets and bedewed them with tears. Friends and strangers alike rushed forward. I stood in the center of the stage as though dazed. I felt a kindly pressure on my shoulder and turned to look into the brimming eyes of my professor.

"You have found it! You are an artist my boy! *Now* you are an artist."

The professor of the young Chicago lady who told the story depicting the difference between being a "genius" and an artist was the great EUGEN YSAYE! The great YSAYE who always plays with head bowed down over his violin, one curly lock hanging over his forehead, oblivious to his surroundings—the great YSAYE who sleeps with his Stradivarius beside him, a violin that speaks to him!

This true story, here told publicly for the first time, has seemed to us worthy of the telling, because of the fact that artistry lies not only in execution, but in the feeling, the inspiration that accompanies it. The humblest may become a great artist in his calling—if the fire is within him!

LIFE IN BUSINESS MEANS—KEEP PROGRESSING!

AN ERUPTION in a large business concern, sometime ago, resulted in the "big man" leaving the organization. Before many hours had elapsed some of the stockholders and a great many of the townspeople began to express weighty opinions regarding how much it would injure the concern, and whether or not it could hold up under the handicap which the loss of this man would entail. Several men holding lesser positions with the concern, began immediately to speculate as to whom the tremendous responsibilities and work would fall upon. Some of them had been waiting for years—simply waiting—to step into his shoes, or at least part of them.

The man himself, who for so long had carried on bravely under the consciousness of his responsibilities, now wonders over the fact that they have gotten along without him. It may be inferred from this that perhaps, after all, he was not really their "big man"—which points out the moral that those who wait for dead men's shoes may at last get them—after they are worn out!

The man who "doped out" the expressions about everything coming to him who waits, being a good waiter, etc., did not realize that the law of progression is growth. He who would gain must get; he who waits rusts. Even the shellfish furnishes an example: When its stony case no longer permits of growth it crawls out and seeks a new place. So must men who would grow leave places, persons and things when their environment prohibits greater enlargement and development.

It is fatal to linger in the ruins of the old shack, which once provided bread and shelter, even though the sentiment is strong. The law of getting ahead is "Keep going upward and onward always."

Don't let your worldly relations cling too closely about you. Don't let them bind you to a place that offers no opportunity. But, when determining this question of opportunity be sure not to blindfold yourself to the possibilities that might exist, or be caused to exist through real effort on your part; and don't expect things to come your way just because you want them to: Do your best. Then, if all efforts fail, don't linger; throw off the dead circumstances and renew your efforts in a new place. Life means progression.

MR. FORD EVOLVES POWER PLANT UNIT FOR STREET CARS

HENRY FORD of automobile, tractor and Eagle boat fame, has completed and tested to his satisfaction an internal combustion engine for the economical propulsion of street cars at high speed. The first try out of the engine took place in the Ford experimental shops at Dearborn, Mich., and both Mr. Ford and his general manager, Mr. C. E. Sorensen, expressed themselves as being pleased with the outcome. Mr. Ford declared that he was convinced the motor would make possible both cheaper and faster urban transportation of passengers.

At the time we write the plans are to send one of these Ford street cars over the rails of the Michigan Central division of the New York Central Lines at seventy miles an hour as a pace-maker ahead of the *Wolverine* flyer, a fast train that runs between Chicago, Detroit and New York. The Michigan Central enjoys a splendidly maintained right of way. The idea will be to have a contest for a time record between the fast, light street car and the swift but heavy steel train propelled by a big compound steam locomotive. This test will soon be made.

The rail transportation world, we surmise, will be keenly interested in this experiment. Self contained power units for urban and inter-urban cars have long been desired for certain classes of transportation. Local traffic in passengers, express matter and mails could be established on frequent-trip schedules between many rail points in this country with such equipment if the service were sufficiently economical of maintenance.

The Ford car power unit is described as being a motor, an air compressor, an electrical generator, and a heating and lighting plant combined. All operations necessary for the control of the car are centred in the motor. A 75 per cent. reduction in weight, as compared with the power and control equipment of the ordinary electric car, is claimed.

Several cities, which have street railway problems, have invited Mr. Ford to demonstrate the cars on their streets. A feature which will appeal to cities which have hilly streets is the hill climbing power of the car. It can ascend a three per cent. grade at twenty miles an hour "on high."

EXIT THE OLD OAKEN BUCKET

THE OLD oaken bucket that hung in the well may be dear to the heart, but it's dangerous to the system.

The time honored well sweep and windlass were one of the picturesque features of the typical Polish landscape—until Polish and American Red Cross sanitarians at the head of the Polish public health work decreed that health was more important than landscapes. Though the bubbling spring by the roadside sounds well in poetry and the maiden drawing water from an old fashioned well is pretty in pictures, every open well is a potential epidemic breeder. With typhus and cholera raging throughout Poland, these wells are considered by the health authorities a direct means of contagion, exposed as they are to all sorts of contamination.

The American Red Cross health experts, who are coöperating with the native government in formulating a permanent health program, have discovered substitutes for the old wells. In the supplies abandoned by the Germans when they were forced to quit the country were found hundreds of pump connections, suction joints and valves in salvage warehouses. These will be used in addition to the modern wells which the Americans are constructing in several towns.

AMERICAN MNFRS. EXPORT ASSN. WOULD AID EUROPE

The American Manufacturers Export Association at its annual convention held at the Waldorf-Astoria hotel, New York, heard several addresses from men of national prominence, and a plea from the French High Commissioner, Mr. Casanave, all outlining the need of extending vast credits to European countries.

The retiring Secretary of Commerce, Mr. William C. Redfield, who is now engaged in business in New York, suggested a practical plan of establishing a powerful corporation with a capital up to a billion dollars, and having the moral support of the government, which should extend credits abroad to governments and all manner of business enterprises, and which should issue its own debentures, in large and in small denominations, so they might be popular investments.

His idea was that there should be a nation-wide selling campaign for these bonds on the lines of the various Liberty Loans, and that the funds thus easily to be raised, should be utilized in this great international business venture to restore European credits and industry, stabilize exchange, renew European industries and enable them to pay their war debts. This would ward off the catastrophe feared by all the speakers touching on the subject. Mr. Frank A. Vanderlip renewed his assertions of the early summer on the exceeding gravity of European conditions, and said that all of the European countries excepting Belgium were in worse case than they had been at the beginning of this year.

Mr. W. L. Saunders, Chairman of the Board of the Ingersoll-Rand Company, and Editor of *Compressed Air Magazine,* was chosen as the new President of the Association, presiding at the annual dinner. He paid a tribute to the work of his predecessor, Mr. George Ed Smith, president of the Royal Typewriter Co., in whose two years of office the Association had doubled in membership.

The Association went on record with the belief that American manufacturers should resume trade with the Central Powers as their individual interests might dictate, but that in allocating output and extending credit they should more particularly favor the countries with which we were associated in the war. Other points made in resolutions passed, were:

That the Senate take early action on the peace treaty:

That official support be given in the form of economic assistance and generous credit facilities to the efforts of patriotic Russians who are endeavoring to create a united and constituent country.

That the necessary machinery for improving and stabilizing foreign exchange should be immediately provided.

That steps be taken to improve the consular and diplomatic service.

That we should assist in the rehabilitation of Europe to the full extent of our ability.

That American manufacturers should take advantage of their present freedom from competition to resume their domestic development.

That to accomplish the desired results labor, for its part, should increase its productive effort as the only possible means of maintaining the present standards of living.

Among the principal speakers at this year's sessions and at the annual dinner, not previously mentioned, were: Louis E. Pierson, Gilbert H. Montague, Frank D. Waterman, Martin W. Littleton, W. L. Saunders, William Phillips, Hickman Price, Allen Walker, C. Lyon Chandler, C. Barthel de Weydenthal, Edmund A. Walsh, Alexander Zelenko, William Graves Sharp, M. A. Oudin, Louis E. Van Norman, Joseph M. Goldstein, Lewis Heck, W. C. Huntington, Lawrence Langner, Frederick M. Corse, W. W. Nichols, W. S. Gavan, Phil Norton, Aco Despitch, Eugene Schneider, Alonzo G. Taylor, Alba B. Johnson, Senator Owen, Colonel Faunthorpe.

James J. Converse, of New York, formerly Acting Secretary of the United States Shipping Board, left recently for an extended tour throughout Poland and other parts of Europe to survey the opportunities for the use of American banking facilities there and to lay the foundation for ship transactions between American shipbuilders and foreign purchasers. Mr. Converse accompanied Constantine Radkieweitz, one time general manager of the Vistula Navigation Company, who came to this country to buy boats for Poland.

Personal Intelligence

The Interborough Rapid Transit Company of New York, operating the subways and elevated lines of New York, has elected Mr. Frank Hedley as president and general manager to succeed the late Mr. Theodore P. Shonts. One of Mr. Hedley's first acts was to summon representatives of the New York dailies and announce that henceforth there would be no secrets from the public in the administration of the system, inasmuch as it was owned jointly by the city and private interests. He recommended "flexible fares" of from eight to ten cents, and that the city should set aside a fund from the increased fares to purchase the properties entire. He made a plea for a fair rate of profit, under the existing conditions, on the money invested by both the city and the company.

* * * *

A. A. Schneider has been appointed manager of the new raw-materials division of the American Steel Export Co., to handle imports, exports, and domestic sales of pig iron, ores, and ferro alloys. He was formerly with the raw-materials department of the Midvale Steel & Ordnance Co. and the Cambria Steel Co.

* * * *

R. W. Creuzbaur, after two years with the Emergency Fleet Corporation, as consulting engineer, has resumed private practice in his New York office. His work with the government was as consulting engineer in direct charge of the three plants at Hog Island, Bristol, Pa., and Newark, N. J.

* * * *

Walter Clark has been elected president of the recently incorporated Liberty Engineering & Construction Co., Murchison National Bank building, Wilmington, Del. The other officials include E. L. Phillips, J. A. Page and H. W. Nutt.

* * * *

Southern Engineering Co., New Orleans, has been organized by C. P. and W. H. Davidson, who were recently released from military service with the U. S. Army. As manufacturer's agents they represent the Buffalo Forge Co., the Buffalo Steam Pump Co., the Schütte & Koerting Co., the Steam Motors Co., the Erie Engine Works and the Corrugated Bar Co. C. P. Davidson formerly was with the Raymond Concrete Pile Co., and W. H. Davidson with Stone & Webster.

* * * *

Horace G. Cooke, who has withdrawn from the Connersville Blower Co., after twenty years of service as eastern representative, has announced the organization of Horace G. Cooke, Inc., to engage in designing and marketing a complete line of rotary compressors, gas exhausters and pumps for the National Marine Engine Works, Inc. The executive and sales offices will be located at 50 East 42d street, New York City.

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A mineralogist of Tokyo, Japan, Mr. C. Matsurbara, has been a visitor in the United States in recent months, making special inquiries into the state of mining conditions in the Rocky Mountain region.

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George T. Castleton of Eureka, Utah, an assayer, is up for membership in the American Institute of Mining and Metallurgical Engineers.

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C. W. Cross has been appointed as manager of western railroad sales by the Chicago Pneumatic Tool Company, with headquarters in the Fisher Building, Chicago.

* * * *

Henry P. Flint, mill superintendent for the Tom Reed Gold Mining Company, of Oatman, Nevada, perished recently while endeavoring to rescue his daughter from drowning, the latter being saved.

* * * *

James W. Burnham, discoverer of the famous "Queen of the Hills" mine in Dry Canyon, near Ophir, Utah, and connected with the mining industry for nearly half a century, was found dead in his bed at the property of the Southern Pacific Gold & Copper Mining Company, at North Ogden, Utah, of which company he was vice president and superintendent.

* * * *

Morris P. Kirk, manager of the Yellowpine Mining Company, Goodsprings, Nevada, has entirely re-equipped that property, both as to mine and mill, and operations are reported by Mr. Kirk as progressing satisfactorily. The mine is known as a regular producer and dividend-payer.

* * * *

Clayton S. Cooper, editorial director for Messrs. W. R. Grace & Co., New York, was the author of a recent article in the columns of the New York *Sun* in which he told how some Yankee business methods were a great puzzle to the skilled Latin-American traders. He related how one South American dealer who ordered hardware received a cargo of coffins.

* * * *

"American Company Shop Committee Plans," a digest of twenty plans for employees' representation through joint committees, is a pamphlet that is of especial value today when exact knowledge of such plans is essential. Bureau of Industrial Research, 289 Fourth Ave., New York. $1.00.

Books and Writers

EMPLOYMENT MANAGEMENT, compiled and edited by Daniel Bloomfield, with an introduction by Meyer Bloomfield, partners of Messrs. Bloomfield & Bloomfield, of Boston. Price, $1.80. New York: The H. W. Wilson Company.

MESSRS. BLOOMFIELD have collected for presentation to employers the best material available on the new subject of employment management, a phrase unknown a decade ago, their compilations and comment thereon comprising a handbook for ready reference. Students of the subject at the various universities will find this a valuable and convenient work. It will be of especial usefulness to industrial executives that are interested in the human problems of management.

In addition to reprints of pertinent material, a selected bibliography is included, together with an appendix containing examples of important forms used in a well-organized employment department of a business. The very title of the book indicates that it is significant of the moment, for one may ransack the literature of as late as ten years ago on the subject of industrial management, but find no reference to "employment management." No college or university school of business training of that day dealt with the problem. Mr. Meyer Bloomfield observes that this does not imply that industrial managers were unaware of what a sound plan of personnel organization meant to industry, for even eight years before the United States entered the world war, with its requirements for high industrial efficiency, there were executives in this country imbued with an understanding that there was a new function developing in business administration, and who were already taking steps to put into practice their perception of this new function.

It has now become a highly essential part of management as a whole, for obvious reasons, and a true understanding of the principles of employment management is proving of great benefit both to the employed and the employer. Unlike many another pioneer idea it has not been obliged to fight its way, but has received ready recognition and welcome.

And here is a point to which the experts call attention and where they sound a note of warning. Standards are not yet all they should be, and vision, fitness and good sense are sometimes missing. There are at least today certain standards by which to measure and criticize and improvements in this important function are bound to come. The book we are discussing will be helpful in the forming of a sound judgment, for its general outlook is sane. We are glad to commend it to all concerned with these pressing problems of employment and we know few industrians in any capacity that are not concerned.

ELECTRICAL GOODS IN ARGENTINA, URUGUAY AND BRAZIL, by Philip S. Smith, Trade Commissioner of the Department of Commerce. Price, 20 cents. Washington: Superintendent of Documents, Government Printing Office.

A MOST promising future for American electrical goods exists in Argentina, Brazil, and Uruguay, according to a report just made to the Bureau of Foreign and Domestic Commerce, Department of Commerce, by Trade Commissioner Philip S. Smith. The use of electricity is widespread in all three countries. The Trade Commissioner's report is a detailed guide published for the benefit of the American manufacturer who wants to make the most of his opportunities in Latin America.

In Argentina and Uruguay the high cost of imported fuel and the lack of water power limit the use of electrity to some extent, but in Brazil the immense amount of water power available makes the electrical field a peculiarly attractive one to manufacturers of electrical equipment. As this water power is found for the most part in the coastal section of the country, it will be available for industrial enterprises and for general lighting, heating, and power purposes in the numerous cities of this section, which includes the greater part of the population of the country.

American materials were not a very important factor in Argentina before the war, but have become decidedly so since hostilities began, the report says. The problem there is to maintain this advantage when the old competition returns. In Brazil, American electrical supplies have always been favored above all others, owing principally to the fact the power plants in the large cities use American materials almost exclusively. Germany's share in the trade, however, was increasing steadily up to the time the war started, and since that time Japanese materials have appeared on the market, although not in large quantities.

THE HOUSING OF THE UNSKILLED WAGE EARNER, America's Next Problem, by Edith Elmer Wood. With Appendix and Index. Price, $2.25 net. New York: The Macmillian Company.

THIS NEW and timely volume, just issued by the Macmillan Company, is the result of careful studies by Mrs. Wood, who enjoyed the advantage of consulting the files of the National Housing Association, and who delved into the history of her subject from days antedating the activities of the late Mr. Jacob Riis of New York, who did so much to stir the consciences of some landlords and was responsible for legislation that forced others to mend their ways.

Mrs. Wood gives a clear and thorough account of the housing problem from various points of view. She discusses the steps in the past which have been made in New York and in other cities, as well as in the United States as a whole. Large industrial corporations and communities that are confronted with housing perplexities, (and where are there not such serious questions to be faced in America today?) should not fail to obtain and study this volume.

The author presents the restrictive legislation that has been adopted and she also takes up the various philanthropic schemes and those of private corporations that have built model dwellings. Her main argument is that the general problem is one which is clearly up to the community, and that it has become a social duty to make sure that the dwellings of even the poorest citizens are clean and wholesome.

The Westinghouse Electric, the Ingersoll-Rand Co., the United States Steel, and scores of our largest industrial corporations have taken important steps in the matter of providing at low cost, for rental or purchase, modern sanitary and comfortable homes for their employees and their experiences in making the worker happy have shown that it pays. Here lies one means of fighting radicalism.

THE CIVIL ENGINEER'S POCKET-BOOK, by John C. Trautwine. Revised by John C. Trautwine, Jr. and John C. Trautwine, **3d. Twentieth** edition, first issue, 1919. 4¼x6¾"; xxvi-1576 pps, including 350 new pages and 1250 illustrations. Gilt edges, thum indexed. Price, $6. Philadelphia: The Trautwine Company. London: Chapman œ Hall, Ltd.

THE TRAUTWINE handbook for civil engineers has been a familiar reference book these many years, its first issue having made its appearance in 1872, but the present issue for 1919 is by long odds the most complete and the foremost work of the sort published in the English language, or for that matter, in any other language. The scope it covers is too well known to engineers to require specific comment here, but it is worth noting that with the printing of the 140th thousand, additions and revisions have been made that place it in the indispensable class.

Great improvements have been made in the textual matter applying to railroads and four times as many pages are now devoted to the subject. Throughout the work great pains have evidently been exercised to guard against typographical and other errors.

We grieve to note the intense modernity of this work in its spelling. While it will rejoice the hearts of the reformers, so-called, who juggle with accepted English orthography, our own old-fashioned eye is repelled with: "such distinction promist increast clearness"; "thoroly checkt"; "altho," etc., which will likewise shock the sensibilities of many old-time Trautwine adherants. F. J. T.

There has just fallen into our hands a multigraphed booklet issued by the Chamber of Commerce of Portland, Oregon, entitled, "General Survey of the Columbia River Gateway Country," showing the industrial, shipping, agricultural and general business conditions and opportunities in the Pacific Northwest. The report also shows meteorological data of interest. The book is filled with charts and maps and statistics as to ports and other cities that will be of value to manufacturers considering the establishment of branch factories on the Pacific Coast. Existing industries, which are varied and important, notably lumbering and shipbuilding, are the subjects of general description.

The efficiency magazine known as *100%* published at Chciago, has built up in its six years of life a constituency of 30,000 subscribers, and is publishing every month practical ideas that serve as a guide and inspiration to business men. A recent issue of this miniature, but prosperous publication, contained articles showing why hour costs are better than those on a per thousand basis; what the Plumb plan means; what is causing industrial unrest; a description of the industrial relations plan put into effect by the Goodyear Tire and Rubber Co. of Akron, Ohio; and an article describing the application of general principles of proper management control to one's business. *100%* appeals to us as a periodical every up-to-date man of business should have on his desk or in his pocket, for it will fit there. It stimulates thought and action.

It is stated in the *Journal of the Society of Automotive Engineers* that a record of 99 per cent was made by the Air Mail Service between Washington and New York for the month of June. The total mileage covered was 11,118, and the total weight of mail carried 15,643 pounds. On the Cleveland-Chicago division, a perfect score of 100 per cent was obtained. In this division, the total mileage was 19,825 miles, and the weight of the mail carried 19,603 pounds. The average speed on that route for the month was 97.8 miles per hour. The operation of the Cleveland-Chicago route is without parallel in the history of aviation. Since May 15, seventy consecutive daily non-stop flights of 325 miles each were made without a forced landing.

Buenos Aires

The First Air Compressor

THIS COMPRESSOR IS A BIT OVERHEATED. THE DRAWING BY BUNNY FROM LIFE* EXPLAINS THE SITUATION. AT TIMES THIS MECHANISM ACTS AS A VACUUM PUMP. A LOW ECONOMY MACHINE.

Not still life.

Excuse cuss words and slang, but we are obliged to put both into the chaste type of this column when we reproduce L. R. Bates' worthwhile verses, "The Heater Boy," from *The California Shipbuilder*:

I'm a "tough guy," people say,
  But I'm damn sure I ain't.
Of course I have a kind of way
  That won't just suit a saint;
But bring me any saint you want
  As soft and white as snow,
Within a week he'll be as tough
  As any guy I know.

Just have him stand one single day
  Before this rivet fire.
A-tossin' red hot rivets ain't
  Like singing in a choir.
Besides there s that damn holder-on
  Who thinks he s learned to curse.
Well, you should hear the riveter.
  By God, he's ten times worse!

Yes, I guess I'm tough all right.
  But you just take my place,
And keeping the rivets blazing hot
  All day; it's no soft race.
And don't set fire to the hose
  Or throw the rivets wrong.
Or hit the inspector in the face.
  It means "good night;" you're gone.

Do you think I like being heater-boy
  Down in a mad-house hold,
With riveters driving a man to drink
  And no danger of catching cold?
But somebody's got to tackle the job,
  And I guess that somebody's me.
I'm sorry if I'm so damned hard-boiled,
  But somebody's got to be!
  (Putting up ships like me)!

It is truly remarkable what a printer, backed with sufficient credit, can make of paper. A writer in the periodical *Steam* comments on how a certain banker paid the U. S. Government $500,000 for thirty pounds of paper. The stock was delivered in sheets about 3x8—and there were only 500 sheets. They were printed in two colors with the statement on each sheet that it would be exchanged by the Government for $1,000 in gold. The banker did not take the paper for redemption to the Government. He exchanged it with several different business men for a fully equipped paper mill. The mill manufactured the same kind of paper which the Government sold for $16,666 per pound, and offered it for forty-five cents per pound unprinted.

SEZ UNCLE SAM

By RUFUS T. STROHM

In *The Coal Age*

"A lot of folks has got the blues
From readin' in the daily news
That every week, ships sailin' east
Take back two thousand men, at least,
That used to labor in our mines
An help to build our railroad lines;
But as fer me, I'm cool an' ca'm,"
  Sez Uncle Sam.

"These fellers don't belong to me,
An' more than that, the country's free;
So when a workman trails his nose,
It's no one s bizness where he goes;
Besides, ef these dubs sail away
Because they hate the U. S. A.,
I'd say that I'm in luck, by damn!"
  Sez Uncle Sam.

"Ef they jes' hanker to git back
Among the ruin an' the wrack,
Where death goes stalkin' to an' fro
In hand with famine—let em go!
I hope they git a stomachful
Of all this socialistic bull.
An' anarchy ad nauseam,"
  Sez Uncle Sam.

"Then, mebby, when they're good an' sick
Of places run by Bolshevik,
They'll want to come back here again
To live with honest, decent men;
Well, then, perhaps they may git by—
Ef I've not raised the bars too high!
That's jes' the sort of guy I am,"
  Sez Uncle Sam.

Bunny entered our sanctum, where we enjoy the privacy of a gold fish, to inquire whether the new trade publication called *Raw Material* is to be classed with *Snappy Stories*. It is with mingled satisfaction and pain that we record the fact that he was promptly thrown out by manly and boisterous persons who were able, unhappily, to overhear his query.

The Marquisian philosopher, poet and humorist of the New York *Evening Sun* declares that perhaps it's not surprising that an aviator found a pocket of hot air at an extreme altitude, for enough of it has been emitted to warm up interstellar space. Fact, but the assertion is too general, and therefore hot-airish. And not all of it is furnished by the politicians. Newspapers have been known to release quantities, though we wouldn't go so far as to say that a colyum conductor, like ourself, as it were, could be accused of warming the upper airs. Anyway, emitting figments of the imagination, so to speak, is not necessarily to be classified as the heating of air. To be exact, what the aviator struck in his journey was a pocket of exhaust from Ingersoll-Rand compressors, says Bunny of that well known company.

THE ENGLISH

By GRACE AGNES TIMMERMAN

In *The New York Times*

Pent in a sea-girt isle, theirs is the soul of the sea—
Dominant, strong and deep; steady and grave and free.
Though the murk of their misty skies
May often dim their eyes,
They can see to fight in the blackest night
For the cause of Liberty.

Well for the weal of the world that their will holds like the rock!
Well for our land at ease when they bore the battle shock!
Ah, we who dwell in the sun,
Where the mingling rivers run,
May serve our race with a lighter grace,
Yet boast of our parent stock.

Summed by a critic eye, their faults and their failings mount;
(Even may be the score with ours, in the long account!)
But they bear the Word of God
Wherever their foot has trod,
And they teach the weak of the world to seek
For wisdom at the fount.

Liberty laughed one day, with Magna Charta sealed.
Craving the whole wide earth, she claimed her an English field;
And she ruled there from that day
With a wider, wider sway,
And her light shone out on the lands about,
And the world's hope was revealed.

Legion have been her foes, folly and greed and pride,
Hunger of pomp and power, and a hundred things beside.
But the English, even as we,
Have striven to be free;
If they scorn one thing, 'tis the headstrong King
Who drove us from their side;

Taught by his wild mistake, they have learned their lesson well.
Ask if their rule be light! Their colonies will tell.
Ask if their cause be loved!
Africa even has proved!
Then cast one glance on the fields of France
Where the slaughtered Anzacs fell!

That which we love, they love; that which they hate, we hate.
Weak was the riven tie but strong is the bond of fate,
And it binds us each to each
With a tie of common speech,
And our common ward, where we stand on guard,
O'er Freedom's vast estate!

PHILOSOPHY AND FOOLISHNESS

There must be something in spiritualism; mediums always seem to have money.

Most folk don't seem to care about becoming angels as long as they can make a good living here.

Some actresses wear plenty of smart clothes to attract attention and cause comment; others go to the other extreme to accomplish the same thing.

When a chap gets to the point where he is satisfied with himself a new entry is made for him in the register of chumps.

A woman who cannot forgive should not become too well acquainted with even the best of men.

If men were all as good as they seem, and women all as good as they look, our churches and uplift societies would go out of business.

The Skeptic.

Rules for Well-Run Offices

1—Conserve air by eliminating unnecessary conversation.

2—Save shoe leather by remaining on the job at your desk. Were you hired to act as a floor walker?

3—During the war we had wheatless and meatless days. Let us now have feetless days, at least as far as the tops of desks are concerned.

4—If you feel that it is absolutely requisite that you reflect your high spirits by whistling or singing, make the tune "Deutschland uber Alles" so that the rest of the office force will have an excuse for dropping a typewriter on your dome.

BAWMIE INTHEBEAN.

CONFIDENTIAL EMPLOYMENT BUREAU

NOTE—Advertisements under either of the classifications below will be numbered in the order of receipt and published free of charge, for the benefit of readers, in the next issue after date. All applications for the use of this convenience should be directed, "Confidential Employment Bureau," Compressed Air Magazine, Bowling Green Building, New York City. Replies to advertisements will be forwarded to the person or persons concerned.

HELP WANTED.

No. 436—Engineer wanted for power plant in southern Wisconsin. Three Stirling boilers, chain grates, 750-kw. turbine, Corliss engine. Must be thoroughly experienced and possessed of self-reliance.

No. 437—Experienced foreman required for manufacturer of general hardware. Location in New England, small but up-to-date plant. State fully age, experience and salary wanted.

No. 438—A production manager is sought by a foundry equipped with all modern foundry appliances. Location, Michigan. Attractive surroundings and right pay.

No. 439—First class pattern maker required. Married man preferred with jobbing shop experience. Steady work for the right man. Location, Texas. Give full information in first letter.

No. 440—Large structural steel plant desires foreman for fabricating department. Must be especially familiar with fabricating of bridge and building. Middle age man preferred.

POSITIONS WANTED.

No. 865—Position wanted either as mining superintendent or assistant by experienced man. At present time connected with a Lake Superior copper mining company. Full information will be given in first letter.

No. 866—Experienced draftsman open for position. Thoroughly capable of laying out work and checking. At present employed.

No. 867—All round foundry superintendent familiar with both heavy and light work open for position. Willing to take an interest in the business.

No. 868—Man thoroughly familiar with malleable iron foundry work open for position as superintendent. Can produce results. At present connected with a going concern.

No. 869—Position wanted by boiler shop foreman who knows how to handle men, and capable of taking complete charge of fabricating and erection. Twenty years' experience with a large eastern steam boiler manufacturer. Eastern location preferred.

Latest U. S. Patents

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

SEPTEMBER 16

1,316,468. FLUID-PRESSURE PUMP. Howard W. Truscott, Jennings Lodge, Oreg.

1,316,469. COMBINED PNEUMATIC MATTRESS AND GARMENT. Ray Werner, San Francisco, Calif.

1,316,507. SAND AND GRAVEL PUMP. Jesse A. Pollard, Oakland, Miss.

1. A sand and gravel pumping outfit comprising a casing adapted to be sunk into the earth until the lower end thereof is projecting into the sand and gravel bed, said lower end being open, a sand pipe open at the lower end positioned in the casing, means for maintaining a certain water level in said casing, an air pipe extending through the upper part of the casing to near the bottom of said casing, said air pipe being connected with the sand and gravel pipe near the bottom of the sand and gravel pipe, a swinging discharge pipe connected with the upper end of said pipe, means acting as a container for receiving water and sand from said discharge pipe, guiding the water to said casing, and a gate for controlling the water as it passes into said casing from said container.

SEPTEMBER 23

1,316,666. MOLDING-MACHINE. Arthur D. Ziebarth, Davenport, Iowa, and Albert V. Magnuson, Berwyn, Ill.

1,316,684. PNEUMATIC STRAW-STACKER. Frank B. Carter, Indianapolis, Ind.

1,316,745. APPARATUS FOR REMOVING PAINT FUMES. Lewis A. Safford, Buffalo, N. Y.

1,316,754. FUEL AND AIR MIXING APPARATUS FOR INTERNAL-COMBUSTION MOTORS. Alexander Winton, Lakewood, Ohio.

1,316,883. AIR-PURIFIER. George C. Fatscher, Lakewood, Ohio.

1,316,937. AIR-BRUSH. Ernest B. Brewster, New York, N. Y.

SEPTEMBER 30.

1,317,235. PNEUMATIC MATTRESS. Charles H. Stonebridge, New York, N. Y.

1,317,308. APPARATUS FOR CONTROLLING THE PASSAGE OF CARS OR VEHICLES ALONG RAILWAYS. Frank H. Nicholson, Wilkinsburg, Pa.

1,317,362. HUMIDIFYING ATTACHMENT FOR GAS-ENGINES. Arthur A. Friestedt, Chicago, Ill.

1,317,363. EROSIVE-BLAST APPARATUS. Ferdinand G. Gasche, Chicago, Ill.

1,317,457. VACUUM-CLEANER. Jeffrey J. Power, Madison, Wis.

1,317,529. SAFETY CAR-CONTROL EQUIPMENT. Walter V. Turner, Wilkinsburg, Pa.

1,317,549. CAR - DOOR - CONTROLLING DEVICE. Christopher P. Cass, Maplewood, Mo.

1,317,638. BLOWPIPE. George F. Naab, Lakewood, and Henry Prell, East Cleveland, Ohio.

OCTOBER 7.

1,317,705. METHOD OF FIXATION OF ATMOSPHERIC NITROGEN. James S. Island, Hamilton, Ontario, Canada.

1,317,809. SAND-BLAST MACHINE. Charles F. Motz, Monaca, Pa.

1,317,827. HIGH-SPEED-GLASS-DELIVERY APPARATUS. Alexander L. Schram, Hillsboro, Ill.

1,317,857. LIFTING-JACK. James B. Bristow, Monroe City, Mo.

1,317,874. FLUID-OPERATED PERCUSSIVE DRILL. Harry V. Haight, Sherbrooke, Quebec, Canada.

1,317,955. PNEUMATIC REGULATOR FOR ENGINE-GOVERNORS. Alexander E Cameron, Providence, R. I., and Robert S Riley, Worcester, Mass.

1,317,959. FROST-PREVENTER FOR ORCHARDS, Etc. Edward S. Cobb, Whittier, Calif.

8. Plantation protecting apparatus of the character described, embodying a vertical stack of a height greater than the plantings to be protected, means for mechanically positively forcing air upwardly through the stack, and means at the upper end of the stack to direct such air outwardly above the plantings to be protected.

1,317,989. ROTARY PUMP AND BLOWER. Lee H. Rogers, Kansas City, Mo.

1,318,307. FLUID-PRESSURE TURBINE. Oscar Anton Wiberg and Sigurd Mattias Backstrom, Finspong, Sweden.

OCTOBER 14.

1,318,350. GOVERNOR FOR PNEUMATIC PLAYER-ACTIONS. Theodore P. Brown, Worcester, Mass.

1,318,358. RIVET-FORGE. Lawrence Crawford, New York, N. Y.

1,318,375. DISTRIBUTER FOR COMMINUTED OR PULVERULENT FUEL. Daniel Goff, Millville, N. J.

1,318,565. DUST-BLOWING ATTACHMENT FOR HANDSAWS. James P. Johnson, Savannah, Ga.

1,318,605-6. APPARATUS FOR CHARGING HYDRO-PNEUMATIC RECUPERATORS OF GUNS WITH LIQUID AND GAS UNDER PRESSURE. Eugene Schneider, Le Creuzot, France.

1,318,617. ROCK-DRILL. William A. Smith, Denver, Colo.

1,318,704. CONNECTING-ROD AND TOGGLE FOR PNEUMATIC DRILLS, AIR-TOOLS, AND THE LIKE. Lewis Sykes, Camden, N. J.

1,318,773. AUTOMATIC MUSICAL INSTRUMENT. Rudolf Kuss, New York, N. Y.

1,318,834. COMPRESSED-FLUID DISTRIBUTER. Louis Bleriot, Suresnes, France.

1,318,863. PRESSURE-REGULATOR. William F. Gradolph, Toledo, Ohio.

1,318,874. ELECTROPNEUMATIC ACOUSTIC APPARATUS. Jurgen Sjoerd Hooghiemstra, Delft, Netherlands.

1,318,881. VACCUM-CLEANER. George C. Kelley, Hammond, Ind.

1,318,897. COMPRESSED-AIR STARTING AND REVERSING VALVE-GEAR FOR COMBUSTION-ENGINES. Thomas Forret Methven, Dalmuir, Scotland.

1,318,925. CONTROLLING MECHANISM FOR AIR-BRAKES. Thomas W. Scott and Harold V. Rudolph, Baltimore, Md.

1,319,022. FLUID-PRESSURE VALVE. Thomas L. Titus, Omaha, Nebr.

OCTOBER 21.

1,319,034. PNEUMATIC IMPLEMENT. Oliver O. App, New York, N. Y.

1,319,059. AIR-CLEANING MECHANISM. Truman B. Funk, Moline, Ill.

1,319,086. SHOCK-ABSORBER. George L. Jacques, Neillsville, Wis.

1,319,311. CAR, AIR, AND ELECTRIC COUPLING. Charles H. Tomlinson, Mansfield, Ohio.

1,319,572-3-4. AIR-FILTER. Vito di Sante, Wichita, Kans.

1,319,667. APPARATUS FOR AERATING LIQUID. Frederick B. Kollberg, Bisbee, Ariz., and Max Kraut, Los Angeles, Calif.

FIFTY SHIPS IN TEN MONTHS FROM HOG ISLAND

With the delivery of the *Nobles,* a 7800 d.w.t. freighter, the Hog Island Shipyard completed delivery of its first vessels to the United States Shipping Board. The total tonnage delivered is 391,250 d.w.t. This is the world's record for shipbuilding in a single yard.

The total tonnage delivered by the American International Shipbuilding Corporation (Hog Island Shipyard) is 105,705 d.w.t. greater than the deadweight tonnage of seagoing vessels delivered from American yards for the year 1916 which was the record pre-war year in ship production. In that year (1916) there were built in all yards in the United States 38 sea-going vessels of 1500 d.w.t. upwards, totaling 285,555 d.w.t.

CLASSIFIED BUYERS' GUIDE

Air Cylinder Oil.
Chicago Pneumatic Tool Co.

Air Lift Pumps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Air Receivers and Reheaters.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Stearns-Roger Mfg. Co.
Wm. B. Scaife & Sons Co.

Aftercoolers, Air.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Stearns-Roger Mfg. Co.

Air Jacks
Chicago Pneumatic Tool Co.

Belting.
Republic Rubber Co.

Blowers.
Cameron Stm. PumpWks.A.S.
Chicago Pneumatic Tool Co.

Blowing Engines.
Cooper Co., C. & G.
Ingersoll-Rand Co.

Catalogue Designers.
Jewett.

Channelers.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Charging Stations.
Porter Co., H. K.

Coal Cutters.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Compressors, Air and Gas.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Hartford Contr's. Supply Co.
Ingersoll-Rand Co.
Powell Co., Wm.
Stearns-Roger Mfg. Co.

Compressor Fittings, Air & Gas
Chicago Pneumatic Tool Co.
Powell Co., Wm.
Republic Rubber Co.

Compressors, Portable.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Compressor Regulators.
Chicago Pneumatic Tool Co.

Conveying Equipment.
Pangborn Corporation.

Core Drills, Diamondless.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Corliss Engines.
Cooper Co., C. & G.

Drill Chucks.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Drilling Machines, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Drill Sharpeners.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Drill Steel, Hollow and Solid.
Inter'l High Speed Steel Co.
Ingersoll-Rand Co.

Dust Exh.-Arrester Systems.
Pangborn Corporation.

Dust Handling Equipment.
Pangborn Corporation

Drilling Stands.
Chicago Pneumatic Tool Co.

Electric Drills and Grinders.
Chicago Pneumatic Tool Co.

Electric Hammer Drill.
Chicago Pneumatic Tool Co.

Electro-Pneumatic Machinery.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Foundry Appliances.
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Ingersoll-Rand Co.
Oldham & Son Co.

Gas Engines.
Cooper Co., C. & G.
Hartford Contrs. Supply Co.

Gas, Gasoline and Oil Engines.
Chicago Pneumatic Tool Co.

Gaskets.
McCord Mfg. Co.

Hammer Drills.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Hammers, Calking & Chipping.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Hammers, Riveting.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Hoisting Machinery.
Lidgerwood Mfg. Co.

Hoists, Air.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Hose Coupling and Clamps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Hose, Steam and Air.
Chicago Pneumatic Tool Co.
Goodrich Rubber Co.,TheB.F.
Ingersoll-Rand Co.
Republic Rubber Co.
Stearns-Roger Mfg. Co.

Intercoolers.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Locomotives, Compressed Air.
Porter Co., H. K.

Lubricating Grease.
Keystone Lubricating Co.

Lubricating Oils.
Ingersoll-Rand Co.
Keystone Lubricating Co.

Lubricators.
McCord Mfg. Co.
Powell Co., Wm.

Meters, Air.
Ingersoll-Rand Co.
New Jersey Meter Co.

Mining Machinery.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Moister and Oil Separators.
Pangborn Corporation.

Motors, Air and Gas.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Motor Trucks & Ry. Motor Car
Chicago Pneumatic Tool Co.
Sprague Electric Works.

Oil Cups.
Powell Co., Wm.

Ore Concentrating Machinery.
Stearns-Roger Mfg. Co.

Photo-Engravers.
Jewett.

Oil Engine Compressor.
Chicago Pneumatic Tool Co.

Pile Drivers, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Plug Drills.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Pumping Systems, Pneumatic.
Bury Compressor Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, Air.
Cameron Stm. PumpWks.A.S.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, AutomaticDisplac'ment
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, Steam.
Cameron Stm. PumpWks.A.S.
Stearns-Roger Mfg. Co.

Quarry Machinery.
Bury Compressor Co.
Cameron Stm. PumpWks.A.S.
Chicago Pneumatic Tool Co.
Hartford Contrs. Supply Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Rock Drills, Air and Steam.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Rock Drill, Electric-Air.
Stearns-Roger Mfg. Co.
Ingersoll-Rand Co.

Sand Blast Equipment.
Pangborn Corporation.

Sand Blast Machinery.
Ingersoll-Rand Co.

Sand-Blast Rooms.
Pangborn Corporation.

Sand Riddling Machines.
Chicago Pneumatic Tool Co.

Separators, Air.
Griscom-Russell Co.

Stone Tools, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Tank, Air.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Wm. B. Scaife & Sons Co.

Tools, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

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Jarecki Mfg. Co.
Yarnall-Waring Co.

Vacuum Pumps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Water Traps.
Bury Compressor Co.
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ENGINEERING

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